Over 200 Illustrations

Electric Wiring

is easy to install with Sears Materials and Instructions

(SIMPLIFIED NEW EDITION)

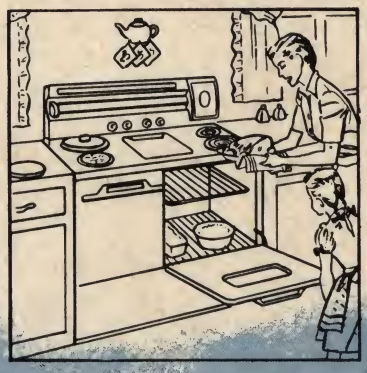
• HOW TO PLAN IT...

• HOW IT SHOULD BE INSTALLED

SEARS, ROEBUCK AND CO.

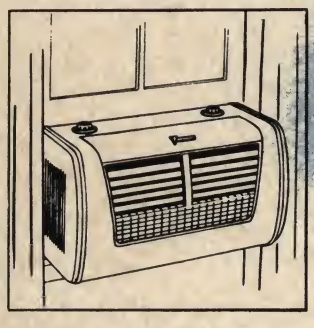
Adequate wiring for the

An electric refrigerator keeps food fresh and edible longer



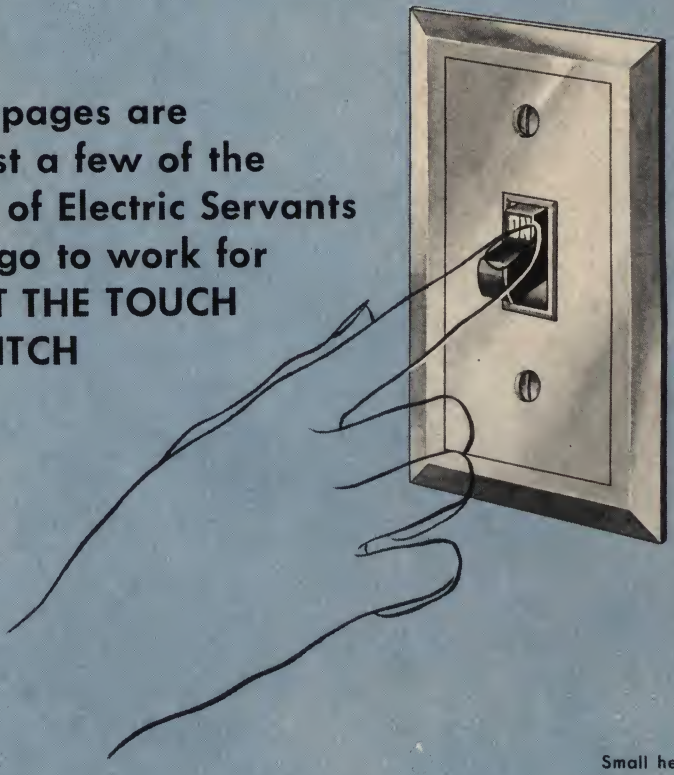
An electric range practically prepares meals for you by itself

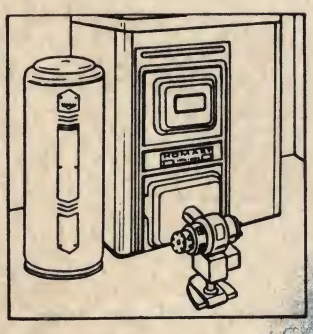
Good light saves eyesight, makes rooms beautiful and attractive



It's always good weather with an Air Conditioner

On these pages are shown just a few of the hundreds of Electric Servants ready to go to work for you... AT THE TOUCH OF A SWITCH





Everything is automatic with electrically controlled heating

Small heaters assure instant heat wherever needed

Vacuum cleaners simplify and speed up house cleaning tasks

Combination Washer-Dryers eliminate all the drudgery

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present and future electrified home

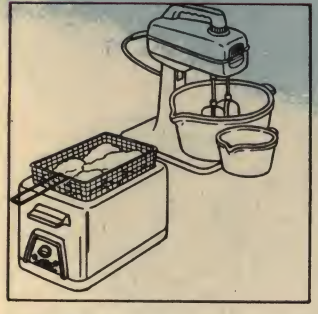
Whether planning a NEW home or remodeling an OLD home . . .

It is important to "wire ahead" for better living. Through shortsightedness and failure to provide sufficient wiring, many homes 10 years from now will be out-of-date because the wiring system will be inadequate to carry the current required by the numerous appliances of the future. Remember that the home of the future will be an Electric Home, equipped with many new Electric Servants such as Electric Dish Washers, Room Coolers, Food Freezer Units, and a host of others. Be sure your wiring is ready for them. For a few extra dollars spent now you may avoid costly rewiring later on.

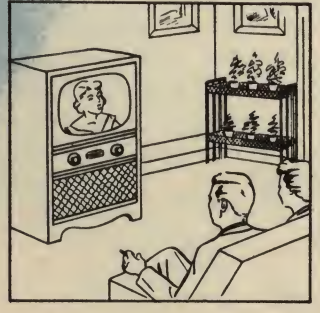
Now is the time to plan. Think not only of the uses you intend to make of electricity immediately but also make a list of the appliances you hope to have in the future – then plan your wiring system accordingly.

Adequate wiring saves money in many ways: Motors run faster and cooler . . . lights burn brighter . . . appliances operate more efficiently when your home is wired to prevent overloads.

Is there anything in your home which you use more than electricity? It works for you 24 hours a day; lighting your home, operating the heating system or air conditioner, helping to prepare and preserve food, to clean your house, to do your laundry, bringing you music and entertainment.

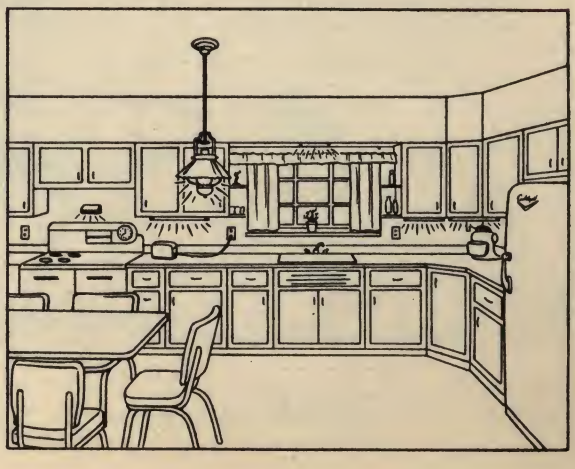


Cooking is faster, simpler with Electric Mixer and Deep Fryer



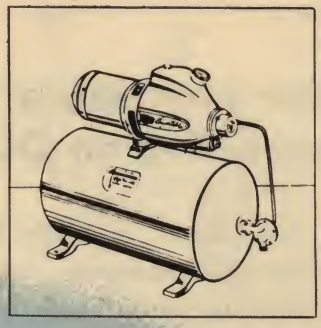
Entertainment for the whole family at the turn of a dial

Bright anti-glare lights and plenty of them are the first essentials of the modern kitchen

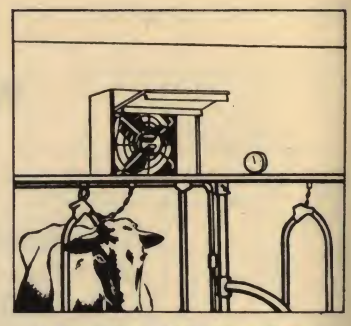


Adequate wiring for the

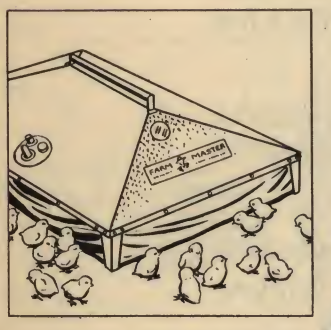
An Electric Milker offsets the drudgery of hand milking



A Water System furnishes running water for both farm and home



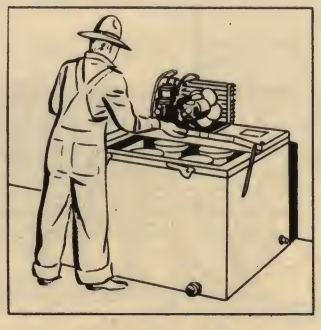
A Dairy Barn Ventilator Means healthier cows, increased production



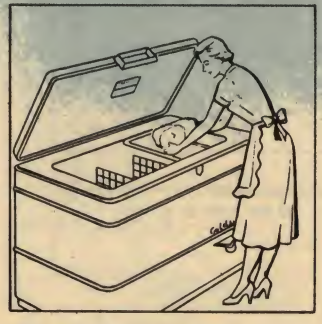
Healthier faster-growing chicks are raised with Electric Brooders

A farm shop with lathe, power saw, drill press, grinder, electric drill, planer, together with good lighting, is a necessity for maintenance of machinery on the modern "mechanized farm."

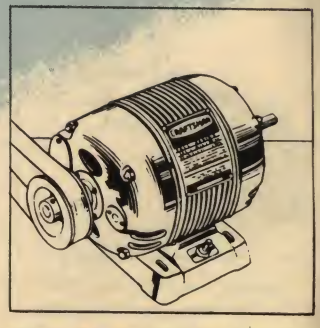
Pasteurizer makes milk safe, a Separator produces cream easily



Premium milk is cooled in an Electric Milk Cooler at low cost



The Food Freezer — for economy and the very best in eating



Always the cheapest hired hand on any farm — an Electric Motor

efficient electrified farm

Electricity is cheap . . saves time and labor . . does as much work for 10c as a man can do all day

Electricity means higher profits. No matter what type farm you own, the intelligent use of the many modern electric servants now available to you, will increase production . . . permit you to do more work in far less time at lower cost.

Put electricity to more uses. Plan for more devices powered by electricity that will save you time and energy . . . allow you to produce a premium product . . . like some of the newer uses in crop drying, bulk milk handling, high-frequency irradiation of seeds.

Look ahead to the day when your farm will be run entirely by electricity and plan for an adequate wiring system. Do not waste electricity. Do not tolerate inefficient operation of appliances or limit the use of appliances because of obsolete wiring.

The more electricity you use the less it costs per kilowatt hour. Rate schedules are on a sliding scale. Table below shows how monthly Kilowatt-hour cost decreases as consumption increases.

Amount of Current Used per month	*Cost per kilowatt hour*
First 35 kilowatt hours used	$3.00 minimum bill
Next 45 kilowatt hours used	4½ cents per kwh.
Next 120 kilowatt hours used	2½ cents per kwh.
Over 200 kilowatt hours used	2 cents per kwh.

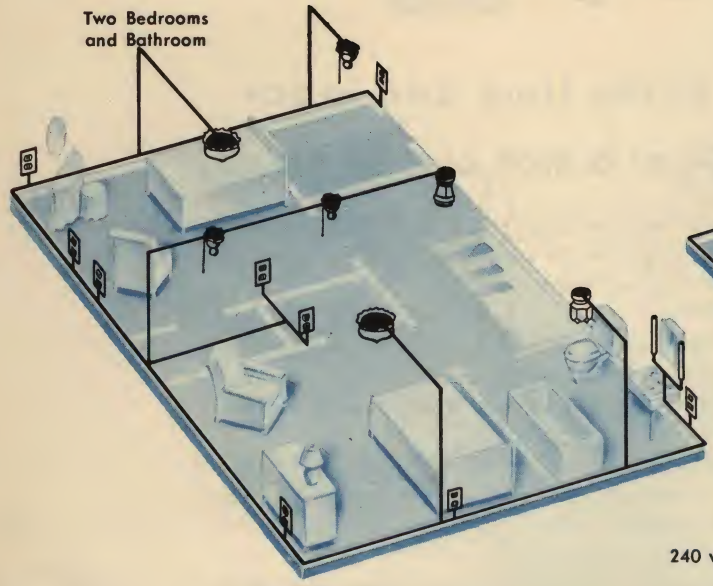
Make your own equipment repairs with an electric grinder

Save time and labor with an electric automatically controlled Hammermill

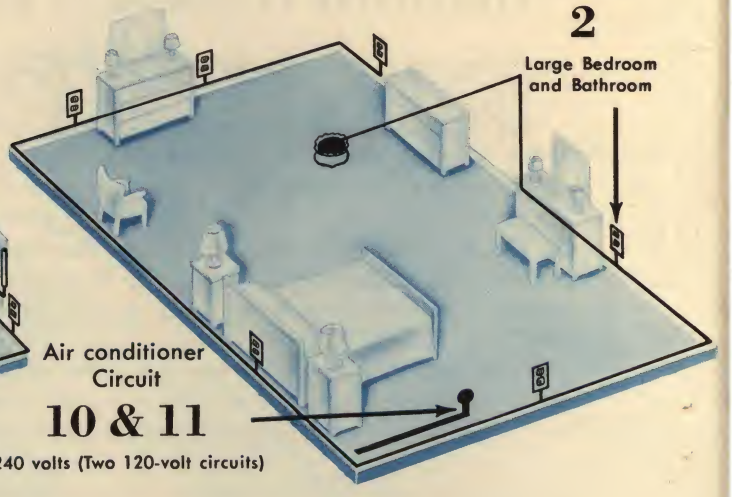
Farmyard and building lighting stretches the working day of farm animals as well as farmers. You can do after-dark chores more easily and safely. Properly placed yard lights prevent accidents and discourage prowlers

Plan ahead...

General Purpose Circuit
1
Two Bedrooms and Bathroom

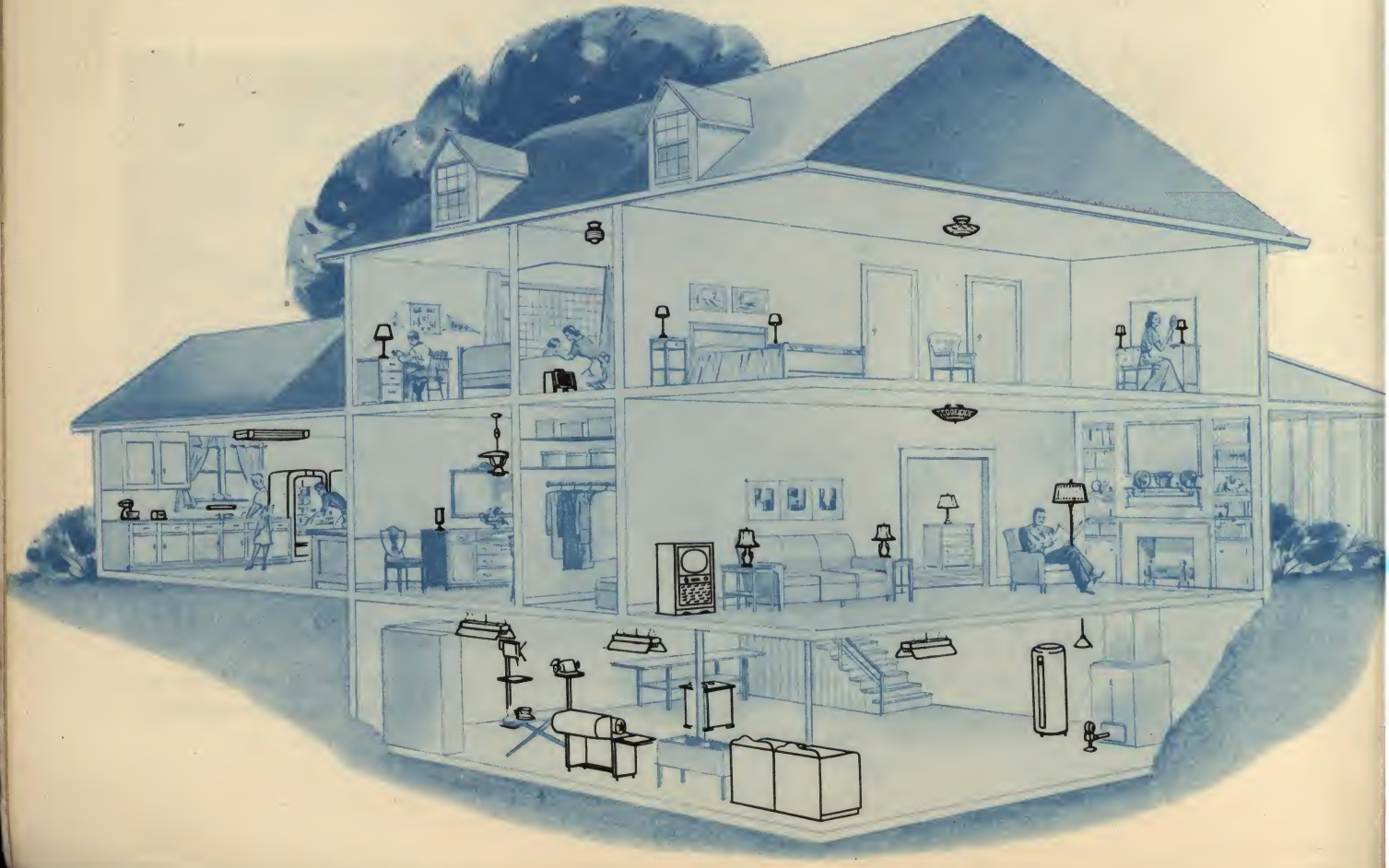


General Purpose Circuit
2
Large Bedroom and Bathroom

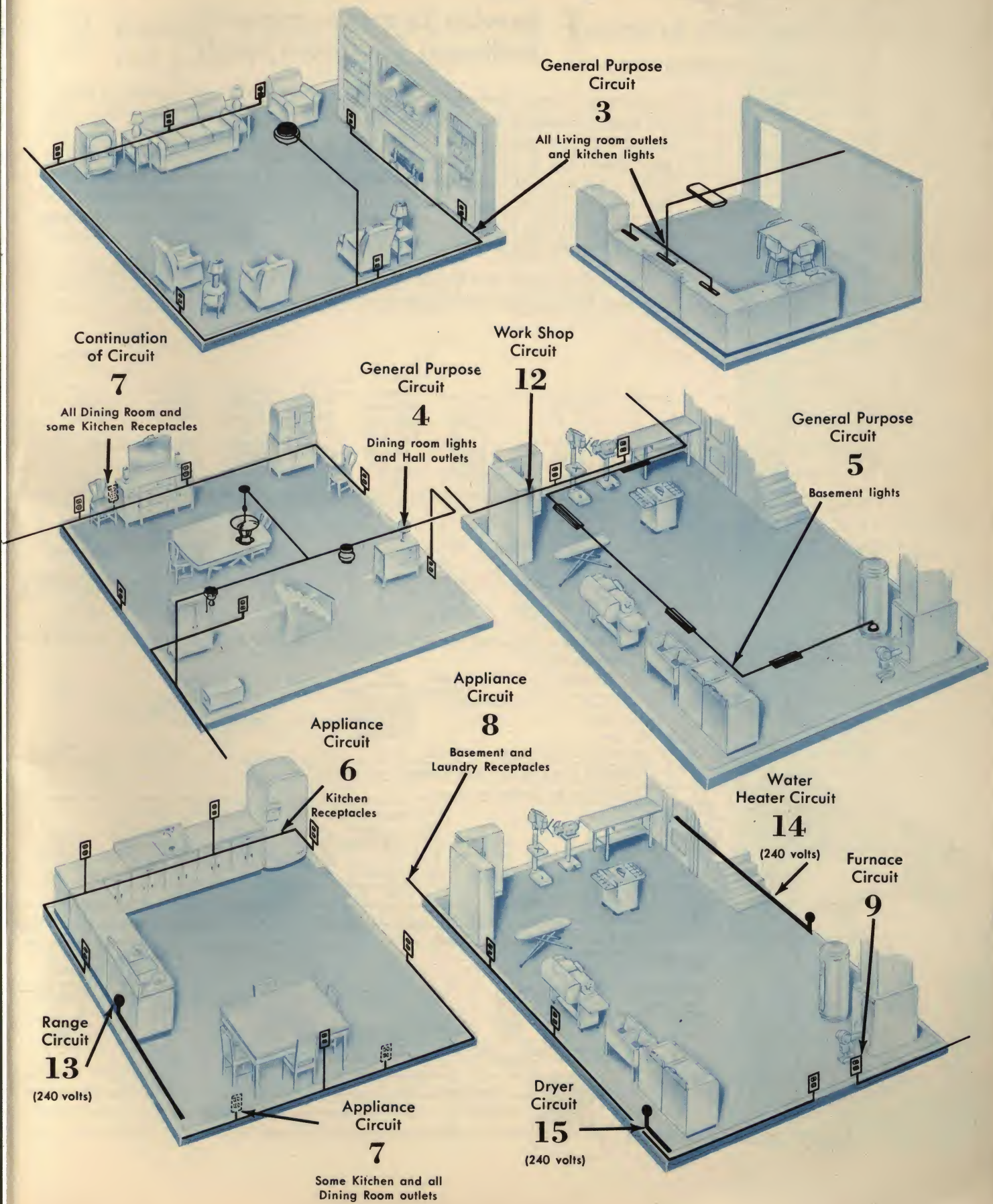


Air conditioner Circuit
10 & 11
240 volts (Two 120-volt circuits)

These floor sketches show a typical average size 6-room house with large basement. The wiring diagrams show why at least 15 circuits are now recommended to provide adequately for proper lighting and all needed appliances, including Electric Range, Water Heater, Power Tools, Air Conditioner.



be sure to provide for future loads

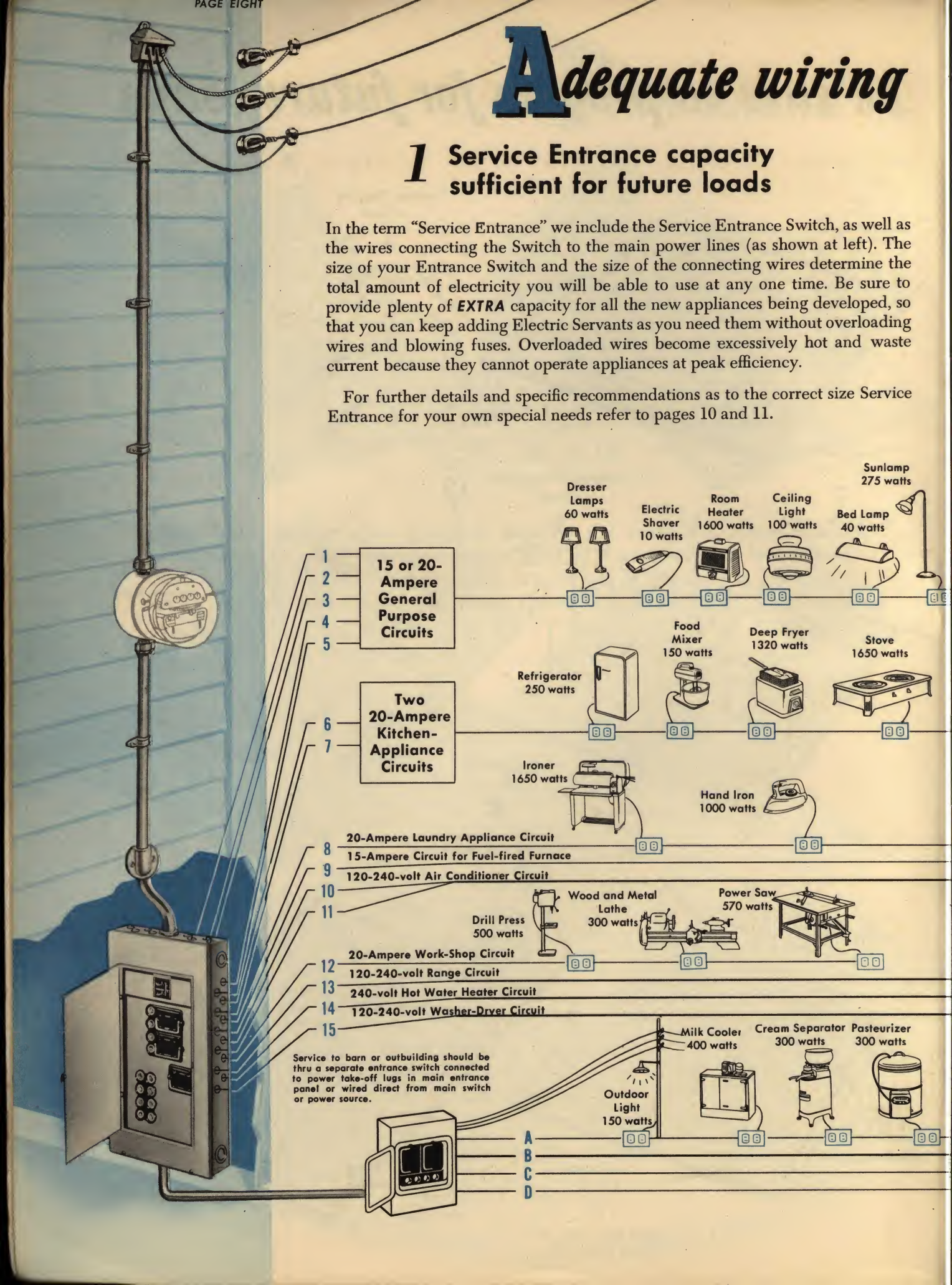


Adequate wiring

1 Service Entrance capacity sufficient for future loads

In the term "Service Entrance" we include the Service Entrance Switch, as well as the wires connecting the Switch to the main power lines (as shown at left). The size of your Entrance Switch and the size of the connecting wires determine the total amount of electricity you will be able to use at any one time. Be sure to provide plenty of ***EXTRA*** capacity for all the new appliances being developed, so that you can keep adding Electric Servants as you need them without overloading wires and blowing fuses. Overloaded wires become excessively hot and waste current because they cannot operate appliances at peak efficiency.

For further details and specific recommendations as to the correct size Service Entrance for your own special needs refer to pages 10 and 11.



depends on these 3 main factors

2 Enough circuits to carry full power to appliances

Divide the lights and outlets into various branch circuits, as illustrated, so that not too many lights or appliances are together on any one circuit at one time.

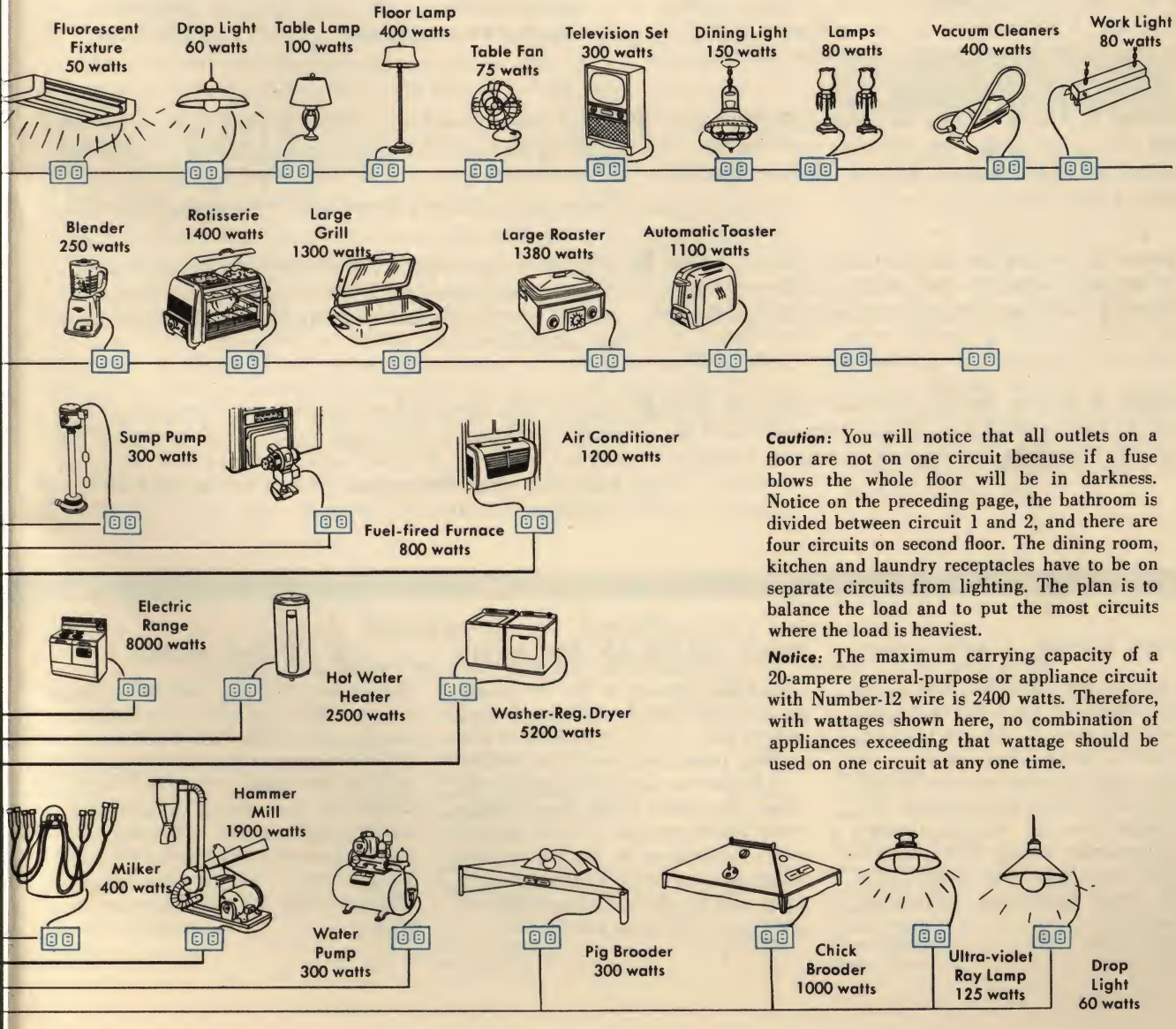
Code Requirements: You must have at least two 20-ampere Appliance Circuits for kitchen, laundry, and dining room and ***entirely independent of lighting fixtures.*** We recommend three such circuits.

A separate 20-ampere General Purpose Circuit is also recommended ***for every 500 square feet*** of floor space or a 15-ampere circuit every 375 square feet.

3 Plenty of Outlets placed in convenient locations

A convenience outlet is recommended for every 12 feet of running wall space, and in kitchens for every 4 feet of work-counter space. Properly located, such outlets provide complete flexibility for quick plug-in of appliances in the exact spots where you want to use them, eliminating the dangers of long unsightly lengths of electric cord. Plenty of outlets also permit better arrangements of furniture and lamps.

Remember, too, to plan a few outdoor outlets for Christmas holiday lighting or appliances.



Caution: You will notice that all outlets on a floor are not on one circuit because if a fuse blows the whole floor will be in darkness. Notice on the preceding page, the bathroom is divided between circuit 1 and 2, and there are four circuits on second floor. The dining room, kitchen and laundry receptacles have to be on separate circuits from lighting. The plan is to balance the load and to put the most circuits where the load is heaviest.

Notice: The maximum carrying capacity of a 20-ampere general-purpose or appliance circuit with Number-12 wire is 2400 watts. Therefore, with wattages shown here, no combination of appliances exceeding that wattage should be used on one circuit at any one time.

How large is "Large Enough" for your

Recommendations for Service Entrance Sizes

Number 2, 3-wire Service Entrance (120-240 volts) with 100 amp. service switch and circuits, is recommended by the Adequate Wiring Bureau for Homes up to 3,000 sq. ft. in floor area. This is the equipment necessary to take care of the all-electric home. With the increase in wattage of appliances, especially range, water heaters and dryers, 125 to 200 ampere service equipment is not uncommon. Dairy and poultry farms need 100 amp. service as a minimum. Where an electric range, a water heater, and an 8700-watt high-speed electric dryer are all to be used, you will require a 125-ampere service entrance as a minimum, connected by 1/0 entrance wires. However, a 200-ampere service entrance with 3/0 entrance wires is recommended as more satisfactory.

This service provides for sufficient capacity for lighting and portable appliances including ironer, roaster, refrigerator, 8000 watt range and 2500 watt water heater, ***plus*** any of the major appliances listed below provided they do not total more than 6000 watts.

Mechanism for fuel-fired Heating	800 Watts
Dishwasher—Waste Disposer	1500 Watts
Room Air Conditioner—¾ ton	1200 Watts
Automatic Washer	700 Watts
Automatic Dryer (Regular)	4500 Watts
Water Pump	300 to 700 Watts
Home Freezer	350 Watts
Built-In Bathroom Heater	1600 Watts

Number 4, 3-wire Service Entrance (120-240 volts), with 100 amp. main lug capacity and circuits, is demanded as a minimum by many local codes and power companies.

This service provides for sufficient carrying capacity for lighting and portable appliances including a range, hot water heater plus any of the major appliances listed above provided they do not total more than 4200 watts.

Number 6, 3-wire Service Entrance (120-240 volts), with 60 amp. capacity and circuits, is the minimum "to get by" with, according to National Electric Code.

This service provides for sufficient carrying capacity for lighting and portable appliances, including a range and a hot water heater ***BUT NO MAJOR APPLIANCES CAN BE ADDED.***

Number 8, 2-wire Service Entrance (120 volt only) with 30 amp. switch box. Should never be used except for temporary services or one-room building.

The service wires and equipment would have to be enlarged before any major appliances could be used. This service provides limited carrying capacity to lighting and a few portable appliances ***BUT NO MAJOR APPLIANCES.***

WHEN BUYING A NEW HOME

Be certain you check the size of the service entrance wires and switch box before you buy. If you are planning to build a new home, be sure the proper size electrical service, branch circuits and outlets are specified. The additional cost of adequate wiring over minimum wiring is only 1% to 2% of the original cost of the home. This small investment pays large dividends.

WHEN BUYING AN OLD HOME

Check the capacity of the service entrance equipment, branch circuits and outlets just as you would check the roofing, paint and general condition.

A home that has 3-wire service entrance has more value than a home with 2-wire service. If you require any modification in electric wiring when moving into a new home—Sears will be glad to advise you and assist you with your needs.

IN EXISTING HOMES

Remember that few homes 5 years old or older, have been rewired to take care of all the uses of electricity. 90% of homes need some rewiring to provide for today's electrical needs. Determine the size of the existing service entrance and make plans for installing new service entrance equipment, branch circuits and outlets. Contact Sears for assistance on rewiring.

service entrance and branch circuits

Recommendations for Circuits (See pages 8-9)

Circuits 1 to 5—General Purpose Circuits. These supply all lighting outlets and all convenience outlets except in kitchen, dining areas and laundry. These circuits should be provided on the basis of one 20-amp. 120-volt circuit for not more than each 500 sq. feet, or one 15-amp. 120-volt circuit for not more than each 375 sq. feet. Outlets supplied by these circuits should be divided equally among the circuits. Convenience outlets should be placed every 12 feet along wall.

Circuits 6 and 7—Appliance Circuits—There should be two 20-amp. circuits in kitchen and dining areas. One of these can also extend to the laundry. If possible a circuit should be run to laundry, which we show under No. 8. No lighting may be installed on these circuits.

Circuits 8 to 15—Number 8 is a 20-amp. 120-volt circuit to the laundry—No. 9 is a 15-amp. 120-volt circuit to the fuel-fired heating equipment. No. 10-11 is a 240-volt circuit to air conditioner. No. 12 is a 120-volt circuit to garage or workshop. No. 13 is a 50-amp. 240-volt range circuit. No. 14 is a 240-volt 20-amp. water heater circuit. No. 15 is a 120/240 volt 30-amp. automatic washer and electric dryer circuit. Automatic washer uses 120 volts . . . dryer uses 120/240 volts.

Power Take-off ABCD—Many farms are now installing a 60-amp. subpanel in the barn connected from the power take-off lugs in the main switch on the yard pole or other location. From the 60 amp. subpanel ***Circuit A*** could go, for example, to milkhouse or barn for lights and equipment. It uses two fuses in the panel and 3-wire in 120/240 volt 20 amp. ***Circuit B*** is connected to the 45-amp. pullout in the subpanel and is a 240-volt circuit for such work as Feed Grinding or large motor. ***Circuit C*** is an individual 120-volt circuit or 240-volt circuit with separate switch for water system. ***Circuit D*** is a 120-volt 20-amp. circuit ideal for supplying poultry house with power for the lighting, heating and brooders.

Note—Number 12 wire is recommended throughout the house. However Number 14 can be used for 15-ampere circuits, and No. 12 for 20-ampere.

WHEN FUSES BLOW

A fuse is a safety valve. It protects wires from overloads. Never substitute a fuse rated higher than the ampere capacity of the circuit. Before replacing a fuse, locate cause of short or overload. Then shut off current at main switch. Wear gloves or rubbers and stand on a dry wood board. Touch one hand only to the fuse—keep the other free, not touching any wall or other object.

CAUTION NOTICE

Any wiring can be made red hot if you attempt to draw too much current through it. Overloaded wires, or improperly fused wires, are dangerous and may cause fires or serious damage to the wiring system itself. You will save money in the long run by observing carefully all the recommendations on these pages, particularly those about fuses. If in doubt about the size Service Entrance you require, always select the larger size.

Check Wattages of Appliances you will use

This list will help you estimate the electric load for every circuit you plan

Appliance	Wattage
Air Conditioner	1200
Attic Fan	400
Automatic Toaster	1200
Automatic Washer	700
Blanket	200
Built-in Ventilating Fan	400
Chicken Brooder	1000
Clothes Dryer (Regular)	4500
Cream Separator	300
Deep Fryer	1320
Dishwasher-Disposer	1500
Dry Iron or Steam Iron	1000
Freezer	350
Griddle	1000
Hair Dryer	100
Heat or Sun Lamp	300
Hot Plate	1500
Ironer	1650
Lamps, each Bulb	40—100
Lathe (9-inch)	500
Milk Cooler	400
Milker	400
Mixer	100
Motors: ¼ H.P.	325-500
½ H.P.	800
¾ H.P.	1100
Oil Burner	250 to 500
Portable Fan	100
Portable Heater	1650
Radio	100
Range	8000
Refrigerator	200
Rotisserie	1375
Roaster	1380
Saw (8-inch)	500-600
TV, Black and White	350
Vacuum Cleaner	300
Ventilating Fan	400
Waffle Iron	1320
Waste Disposer	500
Water Heater	2000 to 3000
Water Pump	300 to 700

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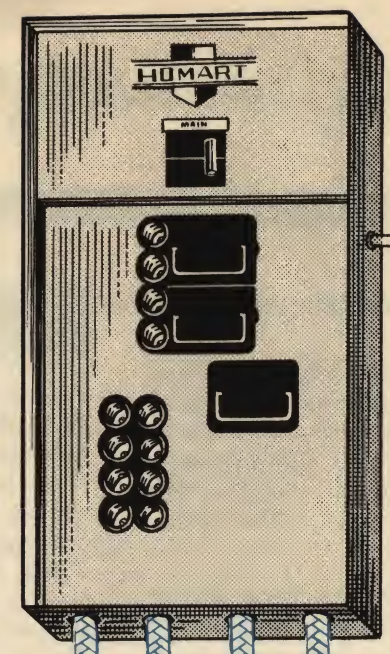


Service Entrance Switch

This is the main distribution panel through which current flows to the various branch circuits. It is really the safety valve for the whole system, because it protects each individual circuit against danger of overload. Also permits you to disconnect your entire wiring system instantly in emergencies or when making repairs.

Grounding System

For protection against electrical shocks every wiring system *must* be grounded. This can be done by connecting the grounding terminal in entrance switch to a water pipe (method used in cities) or by running the "neutral" overhead wire directly down the side of building to a driven outside ground rod (method used for REA installation). See page 21 for details.

One complete circuit

Illustration shows how one 2-wire circuit carries current from entrance switch to several light fixtures, outlets or junction boxes on the same line. Also shows the correct connections for both the white and black wires.

3 Branch Circuits—

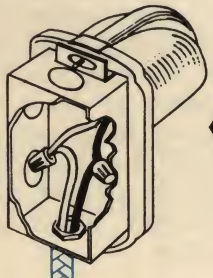
Note rules about "Polarizing" of System

Each circuit has one white "neutral" wire and one or more current-carrying "hot" wires which are colored black or red. Wires are colored for easy identification, so that white wires will be connected only to white wires and the black or red "hot" wires only to "hot" wires.

Correct identification of the "neutral" and "hot" wires throughout the system is extremely important and is known as "Polarizing." Keep the following rules in mind when making installations.

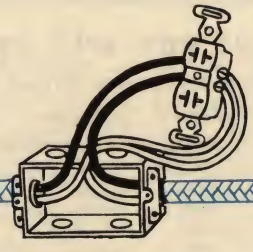
. . . In wiring convenience outlet receptacles the black or red wires must always be connected to the dark (brass-colored) terminal, the white wire to the light (Silver-colored) terminal.

. . . In wiring *switches* the white wire must be run in a direct line from source to every outlet without interruption by a switch. Never connect a white "neutral" wire to a switch . . . the only exception to this rule occurs in certain wiring combinations to be shown later, where the white wire is used as a "hot" wire and *must be painted black*.



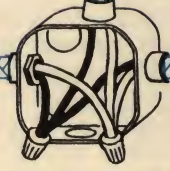
Wall Bracket Fixture

For kitchen, bathroom, or over mantelpiece. Usually these are controlled by a separate switch at base of fixture. Easily installed in an ordinary switch box. No solder or tape needed —use solderless connectors as shown.



Receptacle Outlet

A handy tap from which current can be obtained by inserting a plug. Install plenty of outlets so that you can plug in all types of appliances without use of long extension cords.



Junction Box

A device used to run wiring of a branch circuit in two or more directions. Simply splice white wires together and black wires together using Solderless Connectors. Also sometimes used as a ceiling box for lights or as an outlet box for receptacles.

Basic Wiring System Simplified

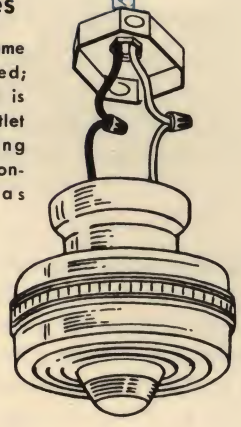
Shows the elementary principles of a Wiring System, illustrating the operation of a single simplified circuit. Also shows how the Black and White wires are connected within the boxes for all the basic devices.

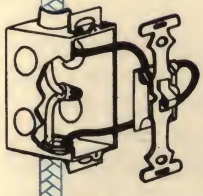
By mastering certain basic principles any competent mechanic can install a wiring system that will perform safely and efficiently. The purpose of this book is to show you how to do it. Let's start with the illustrations on these two pages. They explain the fundamentals of wiring and the functions of various devices.

Note that an electrical system is much like a pressure water system . . . electricity flows from the power lines through the meter and into the entrance switch, which then distributes the electricity as needed to various circuits. For purposes of simplicity, we illustrate only one complete circuit, three lights and one outlet, but you may have any number of circuits, lights or outlets provided the service entrance is large enough.

Light Fixtures

Fixtures come ready wired; all you do is connect outlet wires, using solderless connectors as shown.

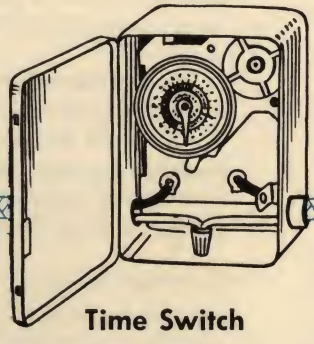




← Light Switch

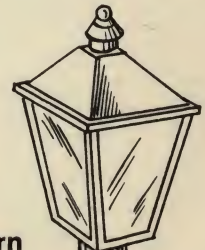
A switch is a device used to break a circuit to interrupt the flow of electricity. The ordinary switch, used to control a light from one point, is shown at left and is called a "single-pole" switch.

Many times it is desirable to have a light controlled from two points, as at the top and bottom of a dark stairway, or you may want a garage light controlled from both house and garage. For this purpose use two "3-way" switches. The method of wiring is shown on page 27.



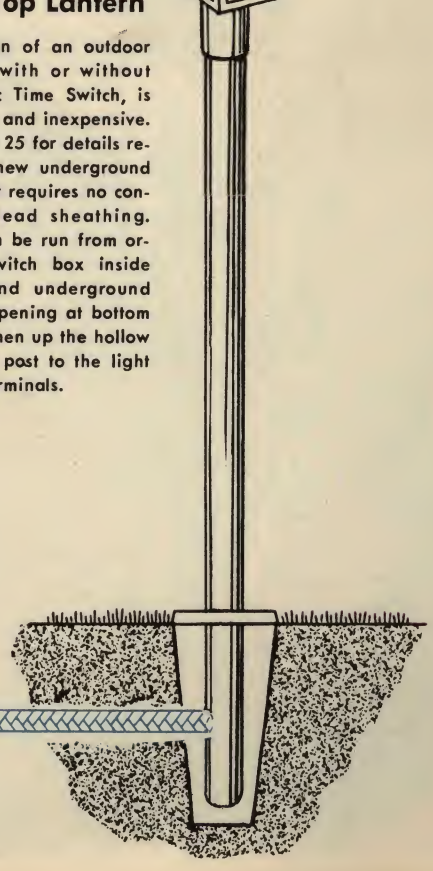
Automatic Time Switch

Turns lights or power off once a day at any times you set. Note that the wiring is exactly as for any other switch, with the two black wires connected to the switch terminals and the white "neutral" wires being connected to each other, by-passing the switch itself.



Post Top Lantern

Installation of an outdoor lantern, with or without Automatic Time Switch, is now easy and inexpensive. See page 25 for details regarding new underground cable that requires no conduit or lead sheathing. Wires can be run from ordinary switch box inside house, and underground over to opening at bottom of post, then up the hollow inside of post to the light fixture terminals.



Simplified instructions for a safe and sound installation

How to Start

The first step is to prepare plans in accurate scale for every building. Such plans help you decide exactly how much material will be needed and also serve as practical working guides when making the installation.

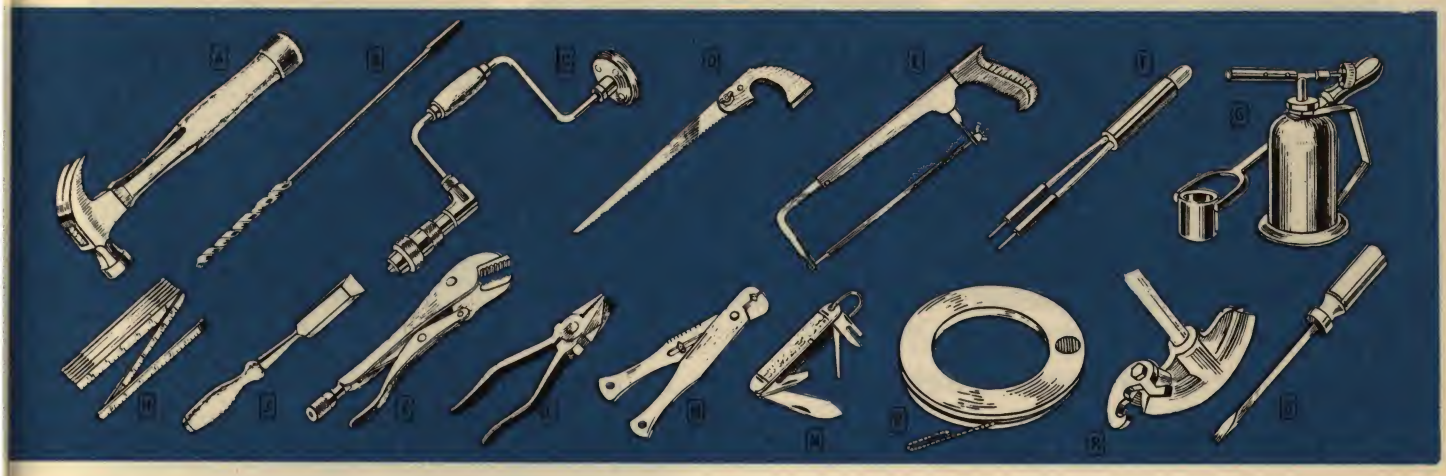
The second step is to consult with your local REA Cooperative or Power Company. They will have helpful information for you . . . advice as to what type of Service Entrance to use . . . whether a yardpole is required . . . how much of the installation the REA or Power Company will handle, etc. In most localities, the Local Utility Company will make the installation to the side of the house or yardpole.

Next, find out whether you need a wiring permit before starting the installation. Securing the permit (if it is needed) should not be difficult, provided you have mastered the information contained in this book and acquainted yourself with the regulations of the National Electric Code so that your installation will pass inspection for safety. The National Electric Code is a printed book of regulations specifying correct installation methods and the types of materials acceptable for various kinds of jobs. Your local REA or Power Company can furnish you with a copy.

Local Regulations. In some communities local regulations sometimes supersede the National Code, so be sure that you know what these local regulations are. Also be sure that the materials you intend to use are approved by your local REA Cooperative or by your Power Company.

When buying wiring materials be sure to look for the Underwriters' tag or stamp to make sure that they meet the minimum standards for safety and quality. Don't take chances with inferior materials which have not been listed by Underwriters.

Tools you need to do the job



[A] **Hammer.** For driving staples, nails, fastening hangers.

[B] **⅝ inch Bit or Drill.** For boring wood or soft metal.

[C] **Bit Brace.** For use with drill, screwdriver, reamer.

[D] **Keyhole Saw.** For cutting circles and irregular shapes.

[E] **Hack Saw.** For cutting cable, plaster or laths.

[F] **Test Light** to trace circuits, test fuses and lines.

[G] **Blow Torch and Dip Cup** for soldering and splicing.

[H] **6-foot Folding Rule.** For measuring wire, openings.

[J] **Chisel.** For notching studs, joists, plaster, flooring and lath.

[K] **Lever-jaw Wrench.** Use as plier, lock wrench, pipe wrench.

[L] **Linesmen's Pliers.** For gripping locknuts, cutting wires.

[M] **Wire Cutter, Stripper.** Details on page 16.

[N] **Jack Knife** for cutting insulation.

[P] **Fish Tape and Reel**—Fish wire thru wall and conduit.

[R] **Conduit Bender.** A handy time-saver.

[S] **Screwdriver** to tighten screws, locknuts.

Explanation of Standard Electrical Terms

A Volt is the unit used in measuring ***electrical pressure*** (like pounds in a water system).

An Ampere is the unit used in measuring electrical ***rate of flow*** (like gallons per minute in a water system).

A Watt is the unit which shows current drain with ***both*** voltage and amperage considered. For example:
1 Ampere at pressure of 1 Volt=1 Watt.
1 Watt used for 1 Hour=1 Watt Hour.
1000 Watt Hours=1 Kilowatt Hour (Kwh.) which is the unit by which electricity is metered.

Horse-power—One HP equals 746 watts

Circuit—Two or more wires through which electricity flows out from the source of supply to one or more outlets, and then back.

Switch—A device for breaking the flow of current.

3-way Switch—A type used in pairs to control the same light from different points (see page 27).

Outlet—A device that permits tapping off electricity at convenient locations for lights or appliances.

Receptacle—A type of outlet to which electric cords can conveniently be plugged in.

Fuse—A safety device which breaks the flow of electricity whenever a circuit becomes overloaded.

Circuit-breaker—Performs the same function as a fuse in the "Circuit-Breaker" types of Entrance Switches.

Service Entrance Switch. The main panel (or fuse cabinet) through which electricity is brought into the building and then distributed to various branch circuits. Contains the main disconnect switch for the entire wiring system, as well as fuses or circuit-breakers.

Conductors—Common trade term for electric wires.

Grounding—The connection of the electrical system to the earth, a precaution necessary to prevent damage from lightning and minimize danger from shocks.

"Hot" wires—The power-carrying wires (usually black or red) as distinguished from the "neutral" wires (usually white).

Insulation—A protective sheathing used over wires to prevent escape of electricity.

"Color-Coding" or Polarizing—Identification of wires by color throughout the system to help assure that "hot" wires will be connected only to "hot" wires and that "neutral" wires run in a continuous uninterrupted connection back to the ground terminal.

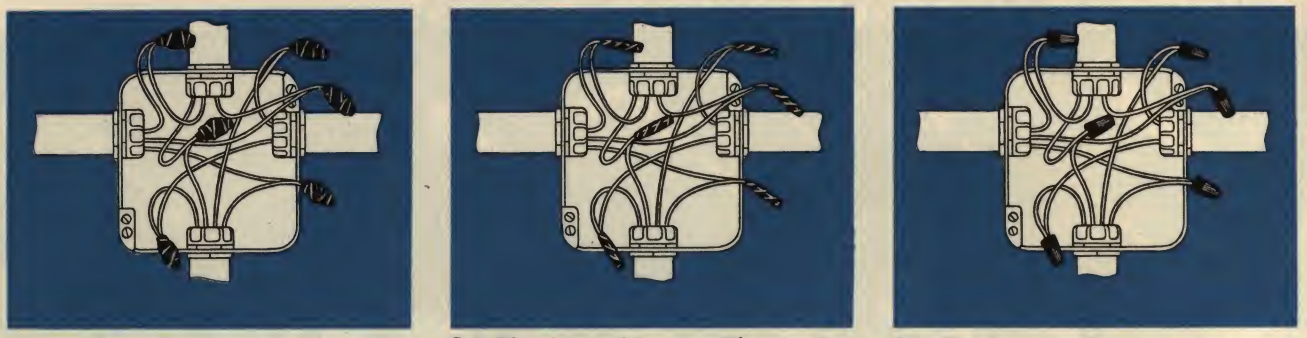
Alternating current—The type of power used in all farm and home wiring systems. Usually 60 cycles, but 25 and 50-cycle systems are used in a few localities and countries outside U. S.

Short circuit—An improper connection between "hot" wires or between a "hot" wire and a "neutral."

Underwriters' Laboratories—A nationally accepted organization which tests all types of wiring materials and devices to make certain that they meet minimum standards for safety and quality. Be sure to look for the Underwriters' tag or stamp on every piece of wiring material you buy. Don't take chances with inferior materials which have not been listed by Underwriters.

"Voltage drop"—A term used to indicate the voltage loss which occurs when wires are overloaded. Always make sure that any wires you install are of sufficiently heavy gauge to efficiently carry the electrical load for all appliances to be connected to them.

Instructions for cutting, splicing,



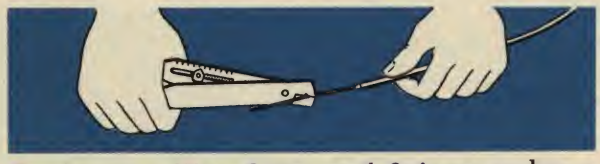
You Can Use Rubber Tape OR The New Neater Plastic Tape OR Solderless Connectors

First step in good electric wiring is to know the right and wrong way to make your wire connections

Joining the ends of two separate wires together is known as a "splice." Joining a wire at right angles to a continuous wire is called a "tap." To make splices and taps as strong as a continuous piece of wire, the job must be done carefully and thoroughly . . . otherwise trouble will result. In joining two or more wires a good connection must meet two requirements: 1) Wires must be bright and clean when brought together. 2) Connection must be tight, well fastened with solder or solderless connectors and covered with tape so that it is as well insulated as it was before original insulation was removed.

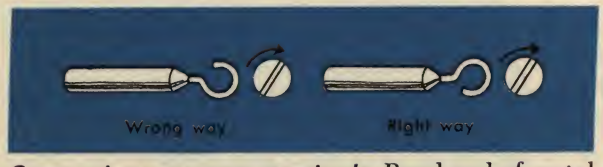
Cutting wire. Remove insulation by cutting at a slant—as in sharpening a pencil. Expose 1/2 inch of copper conductor. Remove all parts of insulation, but not tin coating, which makes soldering easy.

Splicing wires together. Remove about 3 inches of insulation from each wire and cross wires about 1 inch from insulation; make 6 to 8 turns using fingers, and pliers.



Combination Wire Cutter and Stripper makes a handy tool that cuts and strips clean all popular sizes of solid or stranded copper wire. Use also for looping wires under screws.

Tap splices. For connecting the end of one wire at a point on a continuous wire. Use only if there is no pull on tapped wire. Bare and clean the tap wire, then wrap around continuous wire. Solder and tape.



Connections at screw terminals. Bend end of metal wire into a loop to fit around the screw. Be sure to attach loop in direction in which screw turns when tightening as illustrated above.

Dipping wires. Except where solderless connectors can be used, all splices and taps must be soldered. A soldering dipper is convenient for pigtail joints. Apply solder paste and dip wires into pot.

connecting wire

All Splices and taps must be soldered except where Solderless Connectors are used

Applying solder. So solder will flow easier, first coat wires with electrical soldering paste. With soldering iron, heat wires enough for solder to melt into every crevice when touched to them.

Taping. After wires are soldered they must be insulated. First, wrap joints with rubber tape, then cover with friction tape. If wires are not rubber covered, apply only layers of friction tape.

Plastic Tape does a faster, neater, cleaner job. Easier to handle, takes less space in switch boxes. Does the work of BOTH rubber and friction tape. Water-proof, acid-proof.

Solderless connectors eliminate the need for soldering joints. Made of insulating material so wires need not be taped—short circuits cannot occur. Simply screw the connector over wires as shown.

On runs to outbuildings and on power feed lines use Solderless Connectors. ***Use Type A*** for tapping an existing line where there is strain on wires. ***Use Type B*** for all Service Entrance connections and insulate with plastic tape.

Reading the Meter

Your electric meter is furnished by the power company. It is replaced or rechecked at regular intervals. The meter has four dials that look like clocks. Each dial has a hand. Note that two dials read clockwise and two read counter-clockwise.

Write down the number that the hand has just passed on each of the dials in the top row. Suppose the reading on dials is 3456 (KWH) Kilowatt hours as shown above. Let's assume the above figures represent the reading at beginning of the month. Suppose at the end of the month the readings appear as on dials in lower row. Reading as before, we obtain 3592 (KWH) Kilowatt hours. The difference is as follows:

This month's reading.....3592
Last month's reading.....3456
Kilowatt hours used in month..... 136

The plate on every Appliance shows its amperage or wattage. If amperage is given, it is easy to convert the figure into watts. Take the amperage, multiply by the voltage, and this will give you the wattage. Thus a 10 Ampere Iron consumes 1200 watts (10 amp. x 120 volts=1200 watts.) The name-plate on motors gives the horsepower and also the amperes. A 3/4 horsepower motor rated at 4.7 Amperes on 240 volts will consume 4.7 Amps. x 240 volts or 1128 watts.

Remembering that a kilowatt hour is 1000 watts used for 1 hour, and you know wattage of the Appliance you can figure current cost per hour from table below.

Cost per hour to operate small appliances

Wattage consumed by common household Appliances	*If rate is 3c per KWH*	*If rate is 4c per KWH*	*If rate is 5c per KWH*	*If rate is 6c per KWH*
100 watts	10 hrs. for only 3c	7½ hrs. for only 3c	6 hrs. for only 3c	5 hrs. for only 3c
300 watts	3 hrs. for only 2.7c	2½ hrs. for only 3c	2 hrs. for only 3c	1⅔ hrs. for only 3c
500 watts	2 hrs. for only 3c	1 hr. for only 2c	1⅕ hrs. for only 3c	1 hr. for only 3c
700 watts	1.4 hrs. for only 3c	1.1 hrs. for only 3c	1 hr. for only 3.5c	1 hr. for only 4.2c
900 watts	1.1 hrs. for only 3c	1 hr. for only 3.6c	1 hr. for only 4.5c	1 hr. for only 5.4c
1000 watts	1 hr. for only 3c	1 hr. for only 4c	1 hr. for only 5c	1 hr. for only 6c

PART 1

Providing an adequate service entrance

Illustration at left shows a typical Service Entrance installation as usually used in cities or towns. For typical REA installation and methods of grounding the service entrance see page 21. For systems wired from a Yardpole, the meter would be mounted right on the pole.

Your wiring system begins at the Electric Service Entrance which means all the wiring connecting the Power lines to your service entrance switch. Electricity flows along the power lines to your house at full voltage. When it reaches your electric system it needs a large enough entrance. If the service entrance wires are too light or the entrance switch too small, the power will be choked off right there, and you won't be able to get as much electricity as you may need at any one time for several high-wattage appliances.

Size of Service Entrance: Refer to pages 10 and 11 for detailed recommendations as to the size of entrance wires and size of Entrance Switch as determined by the number and type of appliances you intend to use.

Where to locate the service entrance. The power company or REA Cooperative will decide where the service entrance should enter your buildings. If possible locate the service entrance switch near those rooms where the largest amount of current will be needed (usually the kitchen). Wires should be run as directly as possible from service entrance head down the wall to meter and then to the service entrance switch.

The Power Company or your REA Cooperative will usually supply the meter and sometimes will furnish and install all wiring leading into the meter. Wiring beyond the meter is generally your responsibility. The trend today is to have meter located outside your house or on a Pole in your yard.

Service entrance installations may be made in either of two ways: ***1. with service entrance cable, 2. with rigid or thin-wall conduit.*** The materials you use depend upon state or local requirements, so consult your power company or REA Cooperative.

. . . ***Service entrance cable*** (armored or unarmored depending on locality) is the material most frequently used. Its advantages are low material cost and low installation cost. It can be installed around corners where conduit might be difficult to handle.

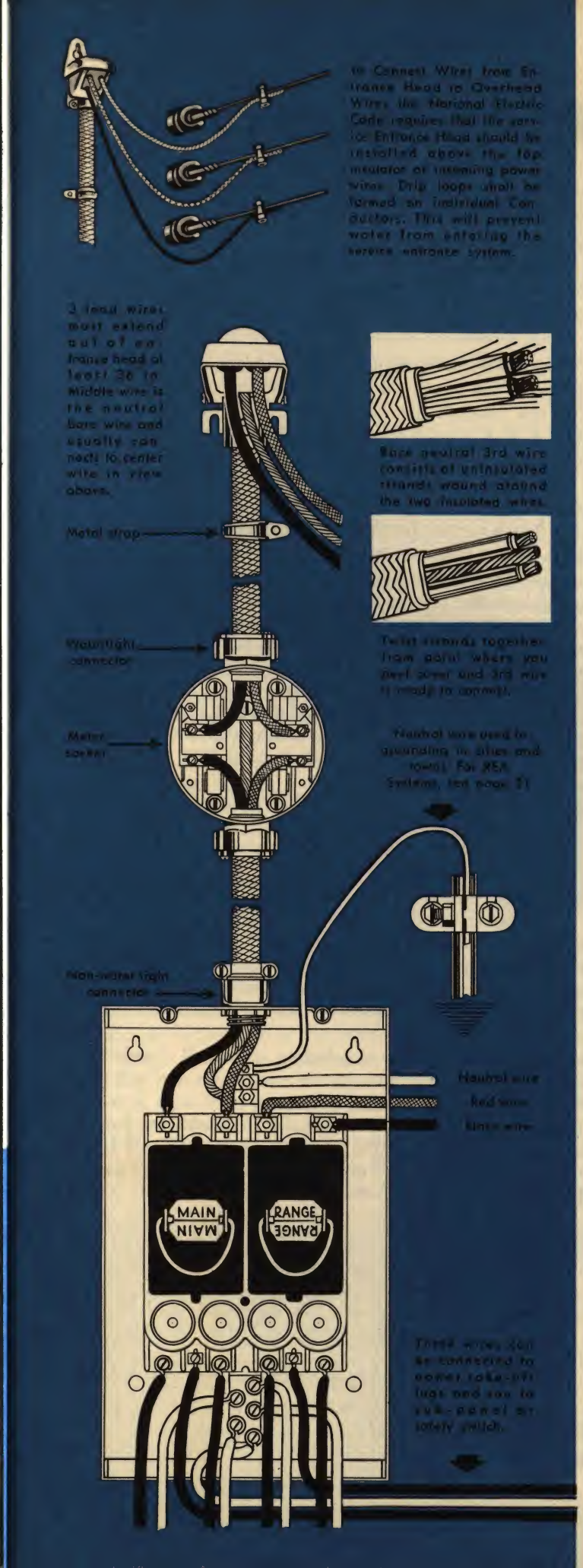
. . . ***Conduit installations*** are made by running insulated wires through the conduit, which is steel pipe (in 10-foot lengths) fastened by couplings.

2 Types of Entrance Switches, Fused and Fuseless

Fuseless Circuit Breaker type, as shown at lower right, eliminates fuses. If circuit is overloaded or shorted, the circuit breaker automatically stops flow of current. Just flip a switch to restore current after cause of the "Short" has been corrected.

Fused-type shown at left is the most common type. Fuses are inside a steel box. Fuses are the safety valves . . . they protect the wires against overload. Never make the mistake of using fuses which are rated higher than the ampere capacity of the circuit. Plug fuses protect the general purpose or appliance circuits. Cartridge fuses protect circuits carrying 30 amperes or more. Pulling out cartridge fuse holders disconnects the circuit.

Service entrance using service entrance cable



How to install: A service entrance head is attached to building at least 10 feet above ground. The end of the entrance cable is stripped of its outer cover so that lead wires can be extended through Service Entrance Head ***at least 36 inches*** as shown. This allows plenty of length for connecting to the incoming power lines. Power lines are attached to buildings with service insulators located high enough to provide clearance for loaded wagons or farm trucks.

Anchor cable every 4 feet with metal rustproof straps. To hold cable in meter socket, use two watertight connectors — one where cable enters meter, and one at bottom where cable leaves meter. Cable is run down wall to hole drilled through side of building and connected to Service Entrance Switch. Switch should be located within one foot of where cable passes through wall. Use a sill plate to protect cable where it enters building.

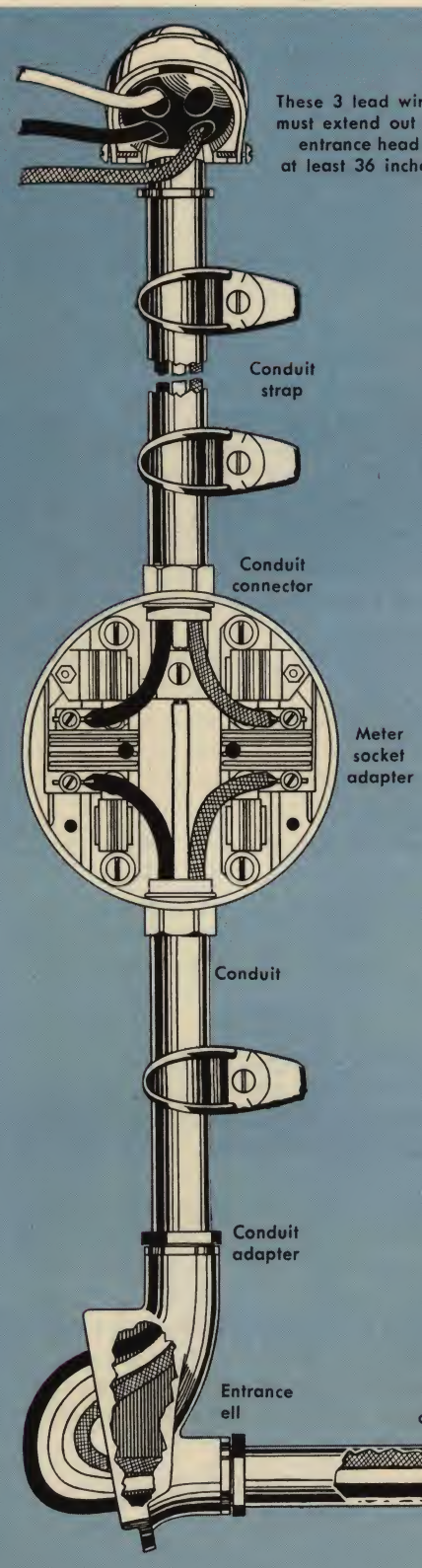
Connections to entrance switch. Black Wire of the Service Entrance Cable is connected to left hand terminal of main disconnect and red wire to right hand terminal. 3rd or bare neutral wire is attached to neutral bar which is used for grounding by connecting it with bare wire to an underground water pipe system (as shown). See page 21 for additional grounding instructions.

Connection of Branch Circuits: Below each round fuse is a terminal to which a black wire is connected. The white wires are connected to neutral bars. A black and a white wire gives a 120-volt circuit, the black wire being fused with a 15 Amp. or 20-Amp. fuse. This box has four branch circuits.

Connection of Power Takeoff: Almost every entrance box of this type has two screws or lugs between the two left fuses and the two right fuses as shown. These are called "Power Takeoff Lugs." If all circuits in the box are in use, you can install another fuse panel or a Safety Switch, and connect it to these two lugs with two black wires plus a white wire to the neutral bar. This will give 120 volts between the black and white wires, or 240 volts between the two black wires, at this subpanel. A fuse panel or safety switch is necessary for protection of circuits to lighting or motors, because the Power Takeoff is fused at 60 Amps. in the Main Disconnect.

Service entrance using conduit

Installation at lower left shows the use of thin-wall conduit. This installation gives a grounded system if conduit or armored cable is used on the inside of your home in runs to all outlets. Thin-wall conduit is not difficult to install. The only tools needed are a conduit bender, hack saw, screw driver, hammer and pliers. Some areas demand that conduit be used exclusively for all Service Entrances. Check your local code.



For 3-wire Service Entrance use one black, one red, one white wire. See pages 10 and 11 for size of wires. Then choose the conduit size as follows:

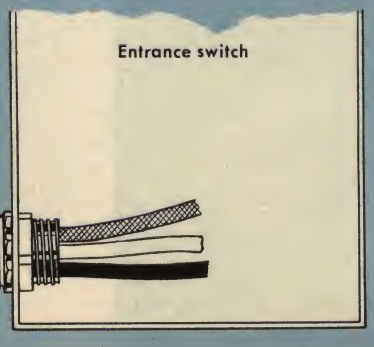
Use ¾ inch conduit for three No. 8 wires
Use 1 ¼ inch conduit for three No. 2 or three No. 4 wires or three No. 6 wires
Use 1 ½ inch conduit for three No. 1 wires
Use 2 inch conduit for three No. 1/0, No. 2/0 or No. 3/0

Runs of service entrance conduit cannot exceed 50 ft.

Service Drop—The wires that come from the utility company's pole to the side of your building or yardpole are called the "service drop." This is usually furnished by the power company. The service drop wires must be high enough to provide proper clearance above grade and must not come within 3 ft. of any door, window, opening or fire exit. The structure to which these are fastened must be sturdy enough to withstand the pull under all weather conditions. Your Power Company or REA can advise you.

Installation of Service Entrance. A service entrance head is attached to building or to a pole erected adjacent to building at least 10 feet above the ground. Conduit is then connected as shown in illustration at left. Use a metal strap every four feet to fasten conduit to building. Connect to meter with conduit connectors. To turn conduit into the building use an entrance ell. Ell has two threaded openings corresponding to conduit size with which it is used. Into the threaded opening at top of ell fasten conduit with an adapter. Into the lower opening fasten another piece of conduit to run through side of house. Connector is used to attach conduit to entrance switch.

Inserting Wires: After conduit is installed, wires are pushed up the conduit through the meter hub into and out of the service entrance head, extending each wire at ***least 36 inches*** to allow plenty of length for connecting to power lines. Then wires are brought down from meter through conduit to the entrance ell. Ell cover can be removed and wires pulled all the way through to the entrance switch.



Connections to service entrance switch are the same as described and illustrated on preceding page, except that for conduit a *white covered insulated wire* should be used as the neutral or grounded wire.

Grounding the service entrance

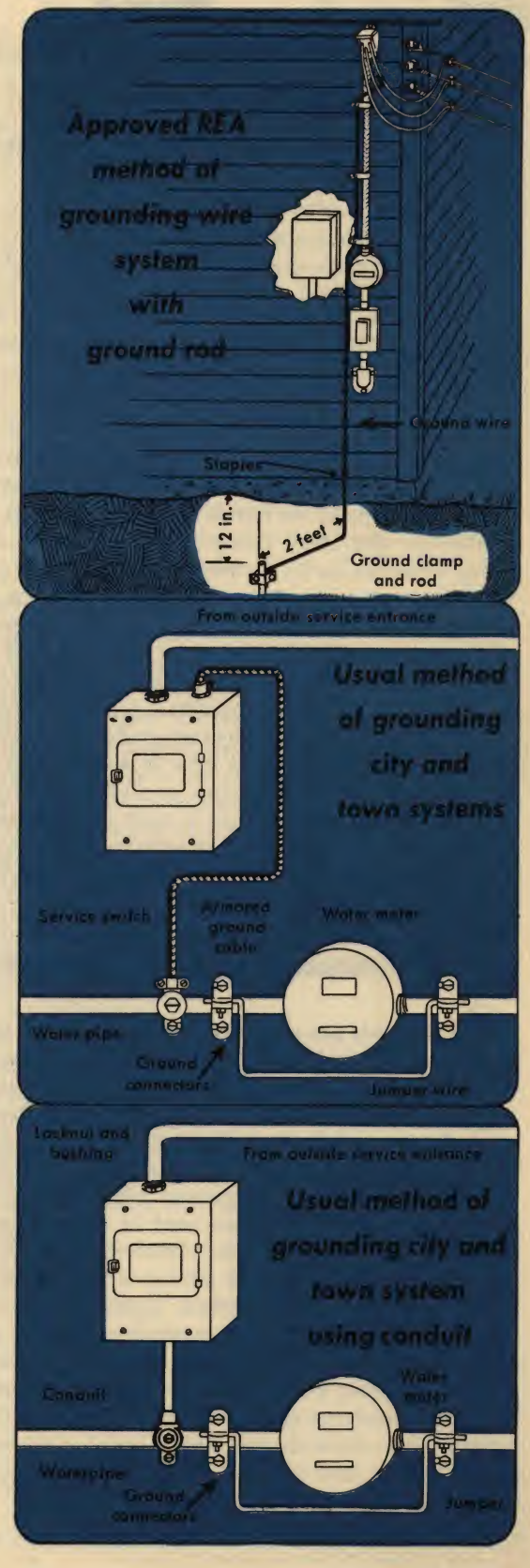
POLARIZATION or color coding

In your electrical system, one wire is black (hot) and the other wire is white (neutral). The black wire is the wire which should be connected to the brass-colored terminal on all switches, receptacles, sockets, fuse boxes and to the black wires on pull chain fixtures. The white (neutral or ground) wire, also called the "continuous wire," is grounded at the entrance switch. It connects to the silver or light-color terminal of all receptacles, sockets, fuse boxes, etc., and to the white wire on all lighting fixtures, but the white wire ***MUST NEVER BE CONNECTED TO A BLACK (HOT) WIRE.*** The only exception to this rule occurs in cases on pages 28-29, where a white wire is allowed to function as a black wire and is painted black. An electrical ground is ***any conductor that connects directly or through other conductors to the earth.*** The "neutral" wire of all alternating current systems must be grounded. Metal raceways, the enclosure for conductors, and the exposed frames of all fixed electrical equipment must be grounded. The grounding of the neutral conductor assures that this conductor will always be at ground potential, and the effect of high potentials or lightning strokes will be reduced. The grounding of metal enclosures and frames of equipment prevents shocks when exposed metal is accidentally livened. The National Electric Code covering grounds is strict and must be complied with. See Power Co. or REA.

Wire used for grounding. Normally you will not need a heavier wire than a No. 6 or No. 4 copper ground wire. This wire is heavy enough to be exposed, provided that the wire is free from danger of mechanical injury. If No. 8 ground wire is used it must be of the armored type (See center illustration) or bare wire enclosed in conduit (See bottom illustration) Check REA or your Power Co.

Ground Rod Installation for a Farm. Approved REA method is shown. Ground wire does not go through Entrance Switch but is tapped off the neutral overhead wire and brought down the side of the house or yardpole to a driven ground rod. You use a copper ground rod at least ½-inch in diameter or a ***galvanized*** iron or steel pipe at least ¾-inch in diameter. Ground rod must be at least 8 feet long, must be located at least 2 feet from any building and must be driven into the earth so that the top of the rod will be at least 12 inches under surface of earth. Ground wire is then attached to rod by a ground clamp which holds it in contact with metal. (See top illustration for other details.)

Ground Installation for City Systems. The ground wire is run from the "neutral" bar of the Entrance Switch to the cold water pipe of the water system. Wires should be attached securely to pipe by a ground connector. If possible, make connections to the water pipe on the street side of water meter. Otherwise connect to any point on pipe but be sure to install a jumper around the water meter by using two ground connectors and a grounding wire, as shown at right.



PART 2 Types of indoor wiring

There are four types now in general use for indoor wiring and available with 2 or 3 conductors. [1] Non-Metallic sheathed cable, [2] Dual-purpose plastic sheathed cable, [3] Flexible armored cable and [4] Rigid or thin-wall conduit enclosing insulated indoor wires. There is also "Knob and Tube" wiring, using insulated indoor wire, but this type is rapidly becoming obsolete and for that reason is not considered in this book. Selection of any type depends on the regulations set up by local authorities, and the type of structure that is to be wired. For some localities, as in large cities, only conduit or armored cable is used, while in some farm communities, all four types may be acceptable. Your REA Co-operative or Power Company will advise you.

1 ***Non-metallic sheathed cable*** (the type most often used in farm wiring) is especially recommended for barns, cellars, basements, outbuildings, and other damp locations; also used in many localities for home wiring. It can be used either for surface or concealed work, but may not be used out-of-doors, underground, or in masonry. It consists of two or more insulated copper wires covered with tough braided outer jacket to resist moisture, fire and acid vapors. Simple to install, it can be attached to floor or wall surfaces, is easily pulled through partitions or floor joists. This type of cable is the least expensive of all the 4 types of indoor wiring described above and the type in most common use. It can be used with any type of switch or junction box . . . steel, porcelain or bakelite. Turn to page 23 for method of installation.

2 ***Dual-purpose plastic sheathed cable*** consists of two or more insulated wires encased in a flexible plastic protective cover. It has all the qualities of regular sheathed cable as described at left but can be used either indoors or out. It is even approved for direct burial in earth, making underground wiring far less expensive than in the past (where underground cables had to be encased in lead sheathing.) It has exceptionally high resistance to damage by fire, vapors, corrosion, rodents, weather or mechanical abuse. Because it is somewhat flat in shape and of an attractive white color it is rapidly becoming very popular for exposed surface wiring in homes to avoid the work and expense of drilling through walls in the alteration of an old building. See page 25 for further details.

3 ***Flexible armored cable with bond wire*** is recommended for indoor use in dry locations, particularly for home wiring. Use it either for exposed runs on wall and ceiling surfaces, or for concealed wire runs in the hollow spaces of wall, floors, and ceilings. (Do not use it out-of-doors or in damp indoor locations or underground.) It consists of two or more insulated wires encased in a heavy galvanized steel protective cover. Armored cable is easy to install, is acceptable in almost all localities, and gives wires ample protection against mechanical injury. May be embedded in plaster finish of walls or ceilings that are not excessively damp. Because of its flexibility, it is frequently used for extensions of conduit systems already installed. But, it must be used exclusively with steel switch boxes and junction boxes, never with bakelite or porcelain boxes. See page 24 for method of installation.

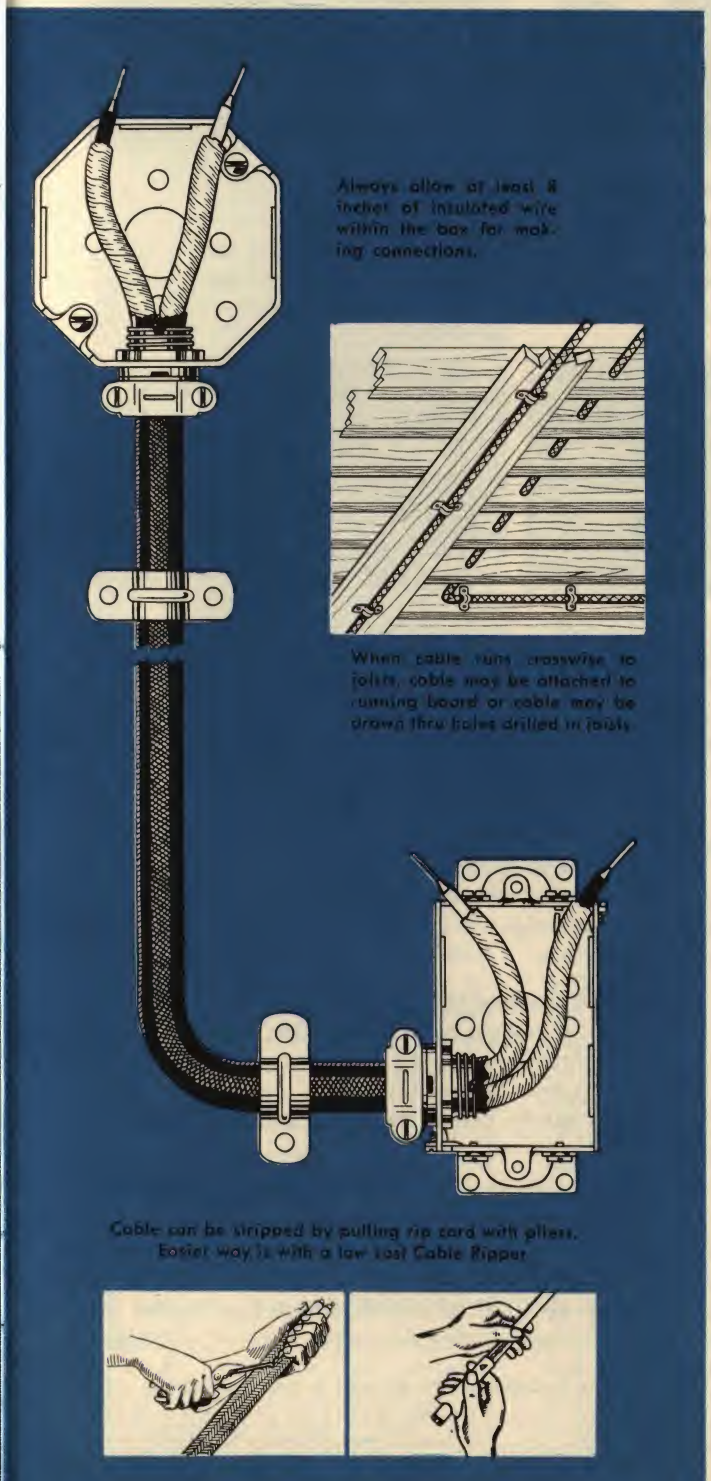
4 ***Thin-wall or rigid conduit*** is the most expensive and most generally accepted form of wiring for ordinary conditions, because it provides greater protection to the wires . . . also because, when correctly installed, it grounds the entire system, an extra safety feature. In many urban communities, conduit is the required method of wiring.

Conduit can be used indoors or out, in either wet or dry locations, and in masonry, fills or concrete (except cinder concrete). It is generally used in "new" work only, because the installation of conduit in old buildings is difficult and expensive.

Rigid conduit is made of high grade steel and is heavily coated with a black enamel or a galvanized finish. Current is carried through two or more insulated indoor wires drawn through conduit. Thin-wall conduit, considerably lighter, is easily cut or bent, and no threading is necessary. See page 26 for method of installation.

Installation of non-metallic cable

Very flexible and easy to handle. Ideal for rewiring or for making additions in old work where you must "snake" wire through walls. For indoor use only.



Non-metallic sheathed cable may be used with either steel, porcelain or bakelite boxes. Splices may be made only within the boxes.

Stripping cable. The protective sheathing is easily removed by a built-in rip cord, which, when gripped and pulled, splits the outer insulation of cable (see lower left). When stripping cable allow at least 8 inches of insulated wire for making connections. A connector is then fastened to outside covering of cable, inserted in knockout hole of box and locknut screwed up tight from inside. Boxes with built-in clamps are also available, in which case no connectors are necessary.

Rules for exposed work. Cable must be strapped every 3 feet and must be run on some supporting surface such as stud, joist, wall or ceiling. When run across joists or through open spaces cable must be supported by a running board (usually 1x2-inch) or drawn through supporting holes drilled in joists. (See illustration at left.) Bends in cable shall be made so that the protective covering of cable will not be damaged. Cable must be specially protected from mechanical injury where necessary by conduit, pipe, guard strips, or other means. When passing through a floor, cable should be protected by encasing it in conduit or pipe extending at least 6 inches above the floor.

In attics or roof spaces cable can be run across the top of floor beams, or across the face of attic rafters at a height at least 7 feet from the floor, provided the cable is protected by guard strips. If attic is not accessible by permanent stairs, guard strips will be required only within 6 feet of nearest edge of scuttle-hole or ladder entrance.

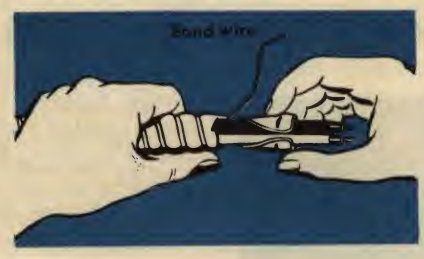
Rules for concealed work. Fasten cable with steel straps (never with staples) at least every 4½ feet, also within 12 inches of every outlet box or switch box. In wiring a new building, straps must be used regardless of whether cable will be concealed or left exposed. In wiring old buildings, straps must be used for all exposed runs, but for concealed runs where wires must be fished through floor or wall, straps need not be used.

Ampere Capacities for Armored or Sheathed Cable

Size Wire	No. 14	No. 12	No. 10	No. 8	No. 6
Maximum Cap	15 Amps	20 Amps	30 Amps	40 Amps	55 Amps

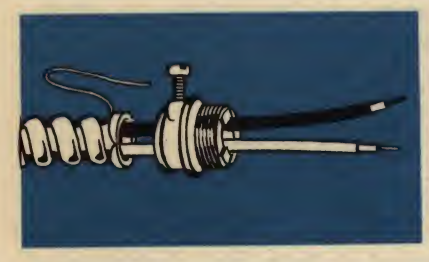
Installation of armored cable

(1) Holding saw at an angle cut through one section of armor, then twist to break. Do not cut into wires. Allow 8 inches of insulated wires for connections inside box.



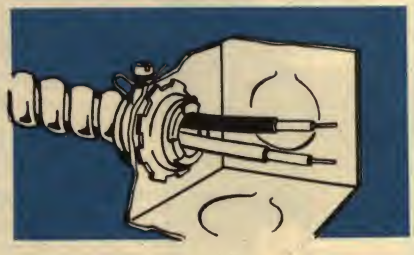
(2) This exposes bond wire and water-repellent paper around wires. Insert bushing between paper and armor. Never overlook this important step.

(3) Next cut off all but 3 inches of the bond wire and bend it back against armor. Bond wire is incorporated in cable to assure a permanently low armor resistance.



(4) Remove paper, slip connector, with locknut removed, over wires, bond wire and armor. Be sure fiber bushing is touching front of connector, then tighten screw.

(5) You are now ready to connect the bond wire. The short end of this bond wire should be securely wound around the set screw of the connector as shown above.



(6) Wires, with connector fastened, are inserted through knockout of the box and locknut is fastened to the connector. Fasten locknut securely to assure a good ground.

Armored Cable Wiring is subject to the same general restrictions as non-metallic sheathed cable. It may be used indoors only and only in permanently dry locations—never outdoors or in barns. Read carefully the rules for both "exposed" and "concealed" work as outlined on the preceding page.

Use steel fittings only. Armored cable may be used only with steel outlet boxes or switch boxes, never with bakelite or porcelain boxes. Box illustrated above is fitted with a cable connector, but boxes are also available with special clamps for armored cable, in which case no connectors are needed. The end of the cable is merely anchored securely under one of the clamps. All splices in armored cable must be made inside a junction box.

Cutting the Cable. The steel strip wound around the insulated wires is easily cut and removed. Take an ordinary hacksaw and cut partially through one section of the armor as shown above. Be sure not to damage insulation of the wires. Grasp cable with one hand on each side of the cut portion and twist sharply. This will break uncut part which can then be slipped off. Always allow 8 inches of insulated wire protruding beyond cut edge of armor for making connections inside the box.

Inserting the bushing. After the armor has been cut away a rough jagged edge will remain. To avoid injury to the insulated wires, the Code demands that a bushing be inserted at the cut end of cable. This is an important safety precaution and must not be overlooked.

Anchoring Cable. Cable must be supported by a strap or staple every 4½ feet and within 12 inches of every outlet or switch box, except for concealed runs in old work where it is impossible to mount straps. Nails may be used to secure straps but screws are preferred to assure a firmer, longer-lasting installation.

Ampere Capacities for Armored or Sheathed Cable

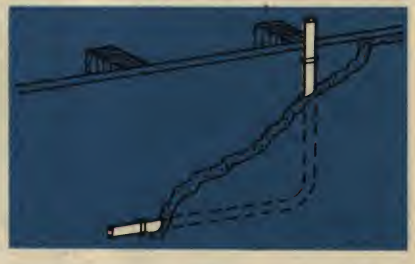
Size Wire	No. 14	No. 12	No. 10	No. 8	No. 6
Maximum Cap	15 Amps	20 Amps	30 Amps	40 Amps	55 Amps

Newest dual-purpose plastic cable

Easily buried underground. Dig trench to depth of 2 feet or more . . . deep enough to avoid injury by shovels, picks, etc. Lay in cable and replace soil.

Use Dual-Purpose plastic cable in the air holes of outside masonry block walls. Dampness and condensation have no effect whatever on this cable. It's economical, too.

For new work this cable can be run in partition through studding, the same as ordinary sheathed cable. It is ideal in damp, wet locations. It is flexible and easy to work.



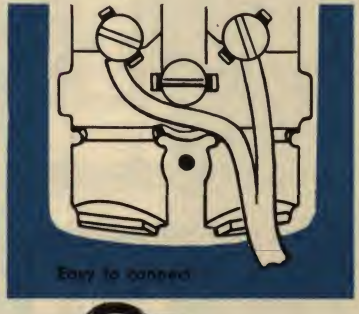
Dual-Purpose cable—so named because it can be used indoors or out, or buried in the ground—also in plaster. Use an armor strip where there is danger from nails.

Makes Surface Wiring Easy

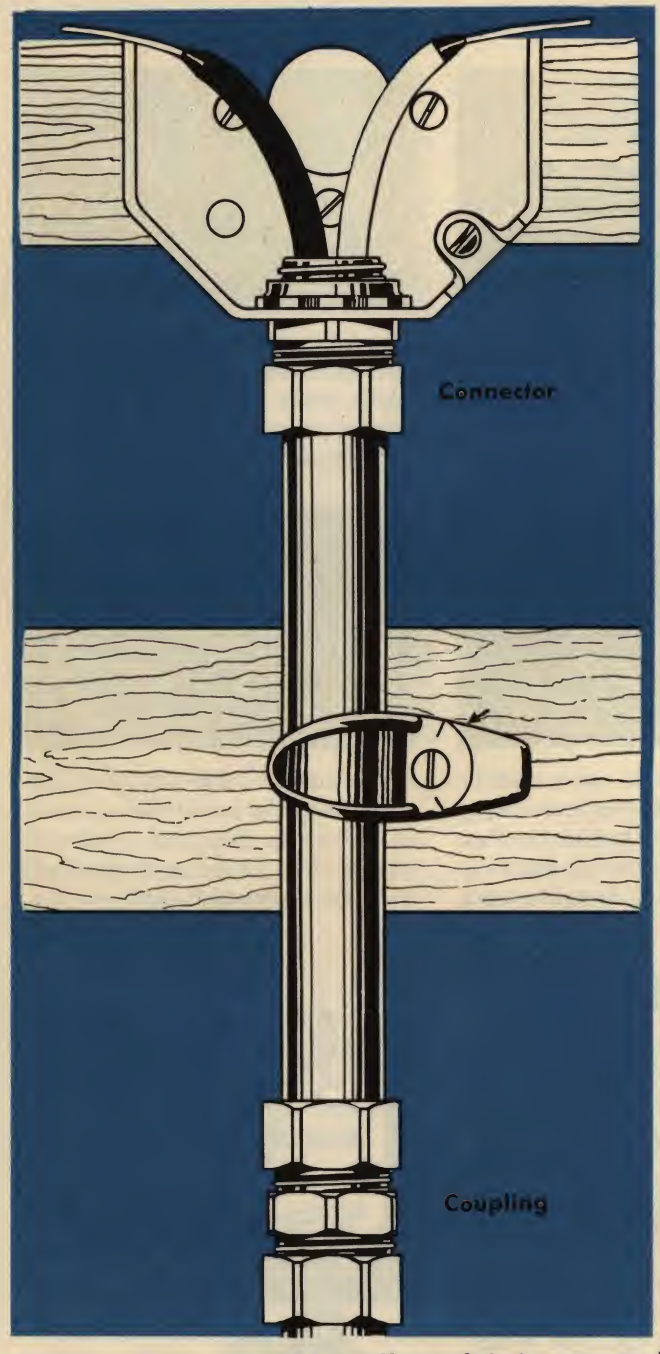
Dual-purpose cable often makes it unnecessary to fish through walls to produce an attractive looking job when rewiring your home, especially in out-of-way places such as pantry, recreation room, work shop, closet or garage. Illustrations above show how simple it is to add a wall switch to control an existing pull-chain light or to install a new light with switch control . . . also how to run a new surface outlet from an existing flush-mounted outlet. Where a molded baseboard is present, you can wire down through back of old outlet, drill hole in baseboard, pull through the cable and run it along groove of baseboard to new outlet. Paint cable to match baseboard.

Surface Wiring Devices

New surface wiring devices such as a bulb receptacle, a switch and a duplex receptacle are available in brown or in ivory color to match the dual-purpose cable. With this combination surface wiring is easy because you don't have to go into plaster, etc., and the outlets and cable are all mounted on the surface and with the light color blend well together. Use the bulb receptacle for putting that extra light in the garage, work shop, pantry, bedroom closet, or any place that you desire. Install an extra surface duplex receptacle at the head of the bed by running along the baseboard and connect to the nearest convenience outlet with this new plastic cable.



Installation of thin wall conduit



Conduit may be used only with steel boxes, never with bakelite or porcelain boxes. Splices and connections may be made only within boxes.

The first step. Empty conduit should be mounted in place and connected to boxes ***before the insulated indoor wires are inserted.*** Conduit is furnished in 10-foot lengths which are joined by couplings. Smaller lengths can be cut with a hack-saw. Cut ends should be reamed inside and tapered with a file to remove rough edges. Conduit can be bent, preferably with a Conduit Bender, or use a pipe "T," connected to a length of pipe for a handle.

Supporting conduit. Use a pipe strap every 6 feet on exposed runs, every 10 feet on concealed runs.

Connecting to boxes. Note that the threadless end of connector has been fitted over conduit and threaded end then inserted through box knock-out where it is secured inside box by a locknut.

Inserting insulated indoor wires. After conduit and boxes are installed the wires may be pulled through conduit and into boxes. To pull wires through conduit use a fish tape or a length of spring steel. Leave 8 inches at each box for connecting wires. Methods of connecting wires are the same as for armored or non-metallic cable. Use white wire for the "neutral," use black or red for "hot" wires.

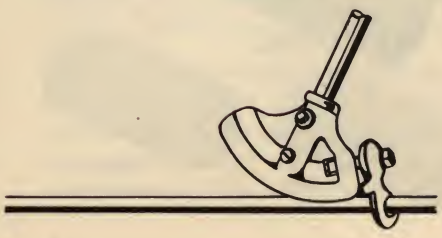
½-inch Conduit carries four No. 14 wires, three 12
¾-inch Conduit carries four No. 10 or 12, three 8
1 ¼-inch Conduit carries four No. 6 wires, three No. 4, three No. 2
1 ½-inch Conduit carries three No. 1 wires
2-inch Conduit carries three No. 1/0, three No. 3/0

In exposed work conduit may be mounted on studs or rafters, without additional protection. ***In concealed work*** between walls or in ceilings conduit must be supported as shown on pages 38-39.

Ampere capacities of insulated wire in conduit. Chart below shows capacity for type "TW" or "R". If type "RH" is used capacity is increased 20%.

Size wire....	No. 14	No. 12	No. 10	No. 8	No. 6
Maximum Cap	15 amp.	20 amp.	30 amp.	40 amp.	55 amp.
Size wire.....	No. 4	No. 2	No. 1	No. 1/0	No. 3/0
Maximum Cap	70 amp.	95 amp.	110 amp.	125 amp.	165 amp.

Thinwall conduit is easy to bend with a conduit bender.



Suppose you wanted a 12-inch 90° bend and were using a combination ½-inch and ¾-inch bender. Measure 7 inches from the end of conduit and mark conduit, place bender on conduit with the inside of hook at this mark, place foot on other side of bender and pull pipe handle until you have a 90° bend. The difference between the 12-inch and 7-inch mark on the conduit is called the "take-up" and this is required for the radius of the bend. "Offset," "back to back," and "saddle" bends are outlined in the instructions included with Sears benders.

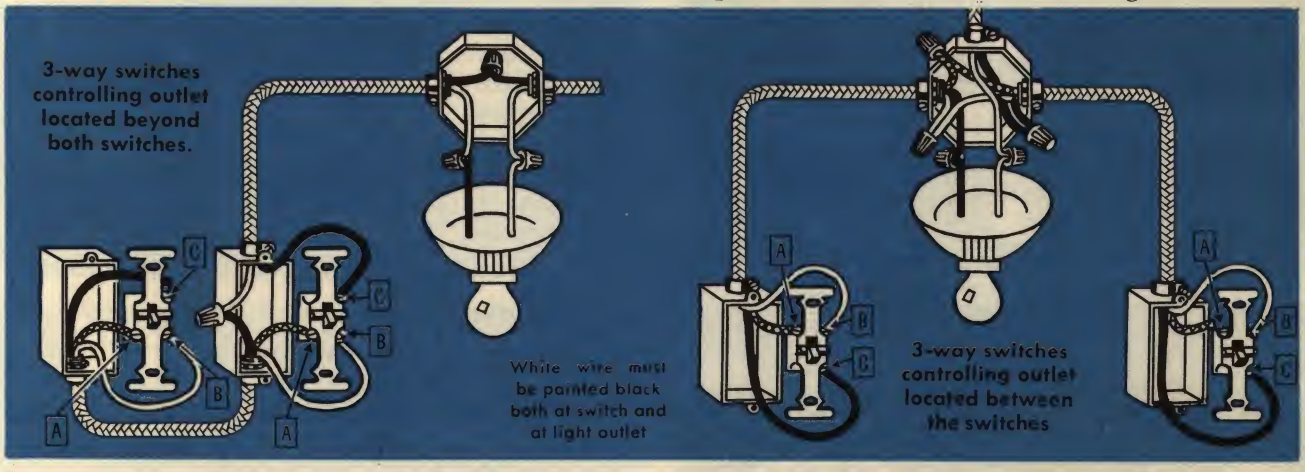
Wiring 3-way and 4-way switches

One 3-way switch at the kitchen door and the other 3-way switch located in dining room. Each controls the ceiling light in kitchen. Saves unnecessary steps.

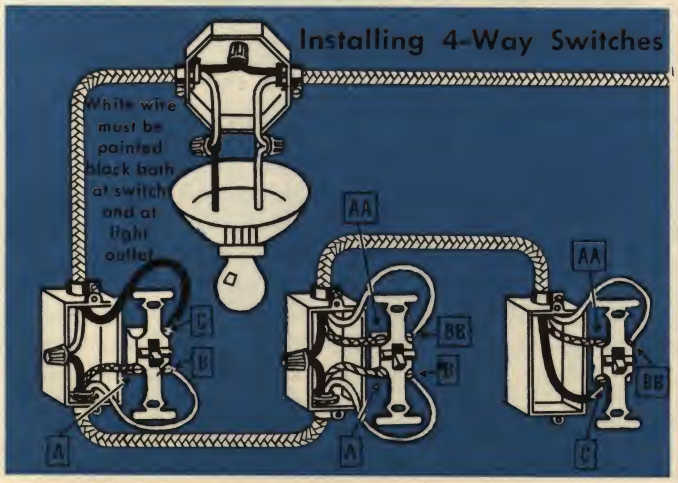
3-way switches located at the top and bottom of a stairway. Each controls the light at head of stairs. Helps avoid the hazards of darkness and unlighted stairways.

3-way switches located in house and garage. Each controls the garage and outside light, eliminating necessity of walking in dark. Also wards off prowlers.

3-way switches located in the house and barn. Each controls the yard light which can be conveniently turned on or off from either location at night.

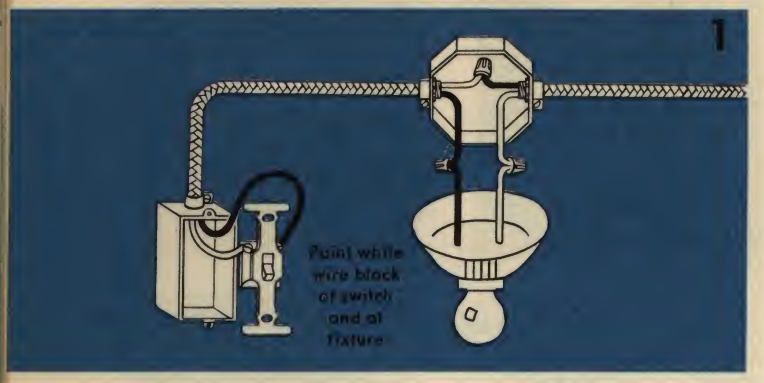


3-way switches above are connected as follows: the black (hot) feed wire is connected to the dark-colored terminal C on switch at right. Light colored terminals A and B on both switches are connected, A to A and B to B. These wires are called "travelers." The wire (Switch Leg) from dark-colored terminal C on switch at left is connected to black (or marked wire) at light fixture. White (neutral) feed-wire is connected to the other wire on fixture. When using white wire as switch leg paint it black.



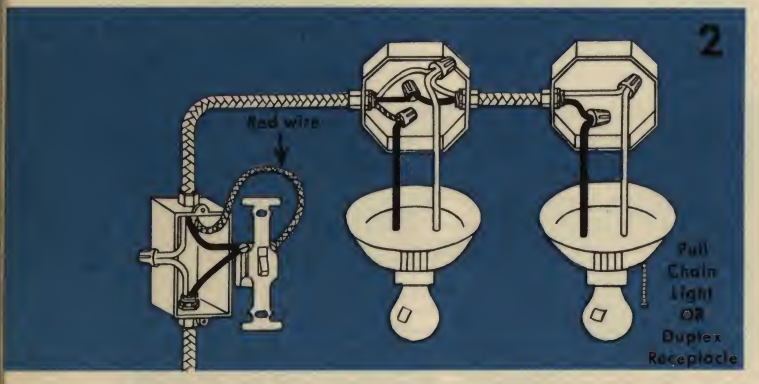
One 4-way switch and two 3-way switches are needed to control one or more lights from three locations. The switches at left are connected as follows . . . black feed wire is connected to terminal C on switch at left. Light-colored terminals A and B on switch at left are connected to light-colored terminals A and B on the center (4 way) switch, A to A and B to B. Terminals AA and BB on center switch (also light-colored) are connected to light-colored terminals AA and BB on switch at right, AA to AA and BB to BB. The white wire (switch leg painted black) from the dark-colored terminal C on switch at right is connected to black (or marked wire) at fixture. White wire is connected to the other wire on fixture. If more than three Control Points are desired, use an additional 4-way switch for each. Connect as shown for center 4-way switch at left.

Wiring diagrams for most common



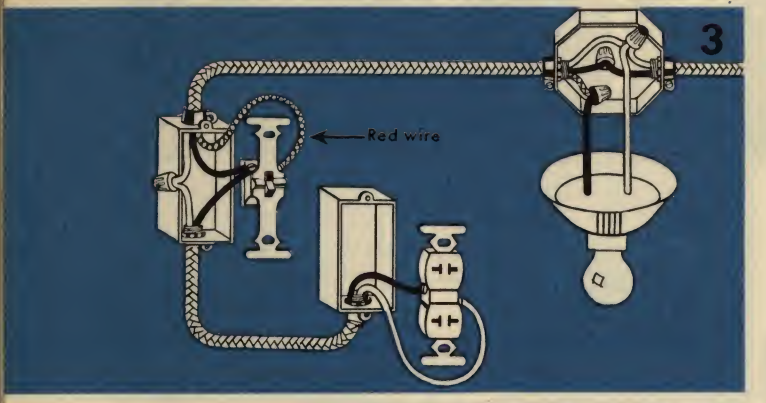
Adding a wall switch to control ceiling light at end of run

Run 2-wire cable (Armored, Non-Metallic Sheathed or Conduit) from ceiling outlet to point where the switch is to be located. Inside the ceiling outlet box disconnect the black wire from the fixture wire and connect it to the white wire which runs to the wall switch. Black wire from wall switch is then connected in ceiling box to the black fixture wire. Note that both ends of white wire from switch must be painted black to indicate that it is a "hot" wire.



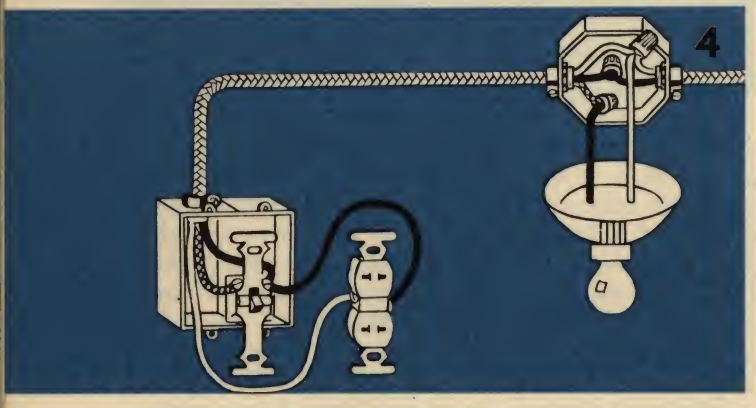
Installing two ceiling lights on same line; one controlled by switch

Conduit would generally be used on "new" work. This wiring scheme can also apply to "old" work . . . for example, adding a closet light from existing bedroom light, using Non-metallic or Armored Cable. 3 wires are necessary between switch and first outlet, two wires between first and second outlet. White wire is run from switch box to both outlets. Red wire is run from one switch terminal to first outlet. Black wire is connected to other switch terminal and is run to second outlet.



Adding a switch and convenience outlet beyond existing ceiling light

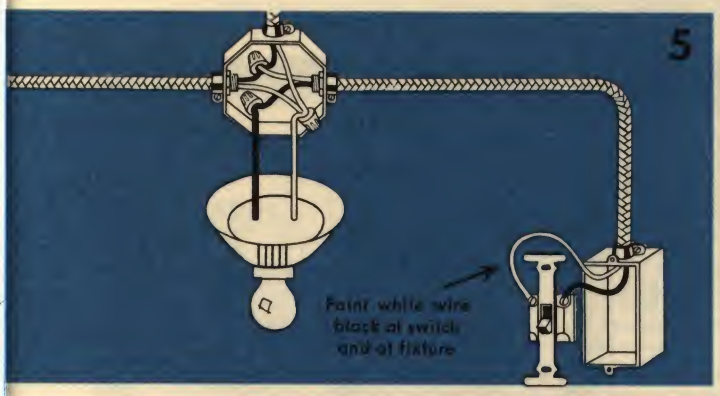
So that outlet will be independent of switch and always "on", 3-wire cable from the ceiling outlet to the switch box is necessary. However, 2-wire cable is used from switch box to outlet. The black wire is connected to one terminal of the switch . . . it also runs to the dark colored terminal of the outlet. The red wire is connected to the other switch terminal, and the white wire is run from ceiling outlet, past switch to light-colored terminal of the outlet.



Adding a switch and convenience outlet in one outlet box beyond existing ceiling light

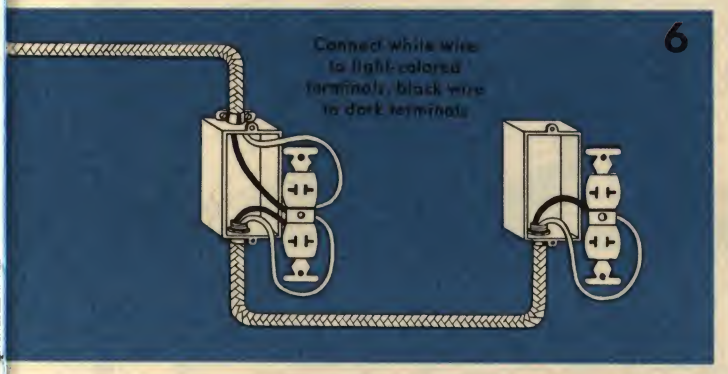
Join boxes as shown on page 35. Run 3-wire cable from ceiling light, connecting red wire to one terminal of switch and to the black fixture wire at ceiling outlet. Connect black wire to the other terminal of switch and continue to the brass (dark-colored) terminal of receptacle. At ceiling outlet connect black wire to feed wire only. Now connect the white wire at ceiling light to the feed and the other fixture wire. At new outlet connect white wire to the silver (light-colored) terminal of receptacle.

switch and outlet combinations



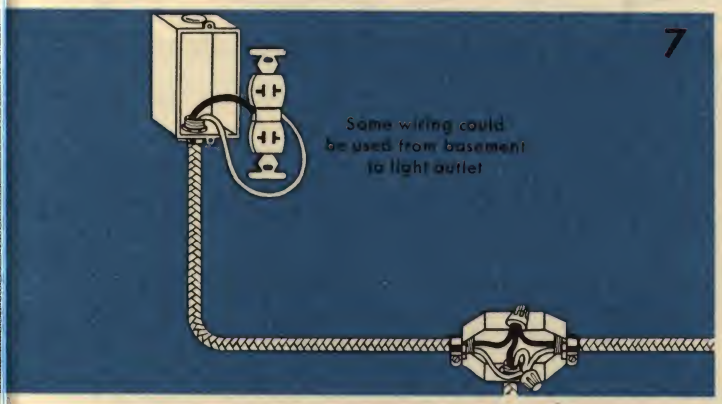
Adding wall switch to control ceiling light in middle of run

In this case the circuit is continuous through the ceiling outlet to other outlets on the same line. The same wiring is used as in No. 1 (opposite page). The difference is that wires leading to switch are tapped off in the ceiling box as shown. Black wire from switch must be connected to the black wire of fixture. Connect white wire from switch to black wire in ceiling box. Both ends of the white wire from the switch must be painted black to indicate that it is a "hot" wire.



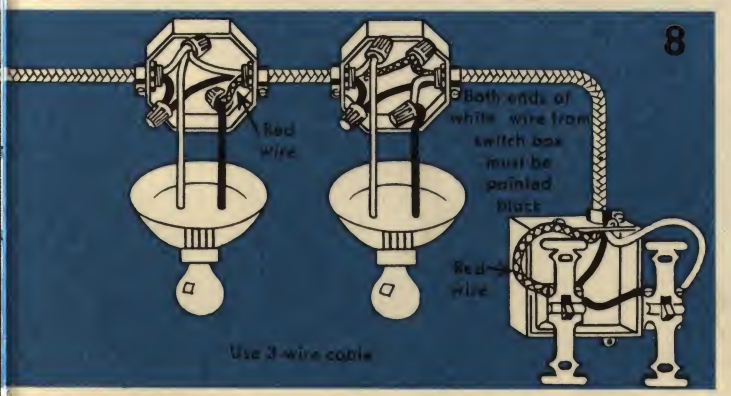
Adding new convenience outlets beyond old convenience outlets

Providing plenty of outlets in each room keeps rooms free from tangled cords. Wiring from one outlet to another is simple as illustration shows. Select the spot where new outlet will be located and prepare opening for outlet box. Use 2-wire cable (Non-Metallic Sheathed, Armored or Conduit). Connect the black wire of cable to the dark (brass-colored) terminals of both the old and new outlets. Connect the white wire of cable to the light-colored terminals of both outlets.



Adding a new convenience outlet from an existing junction box

This method is usually used where junction box is in basement and outlet is to be on floor above. Use 2-wire Armored Cable, Non-Metallic Cable or Conduit. Within junction box tap the black wire and connect to black wire leading to the convenience outlet, then do the same with white wires. In connecting outlet, hook black wire to the dark brass-colored terminal and white wire to light-colored terminal. For how to bring wires up through floor, see page 35.

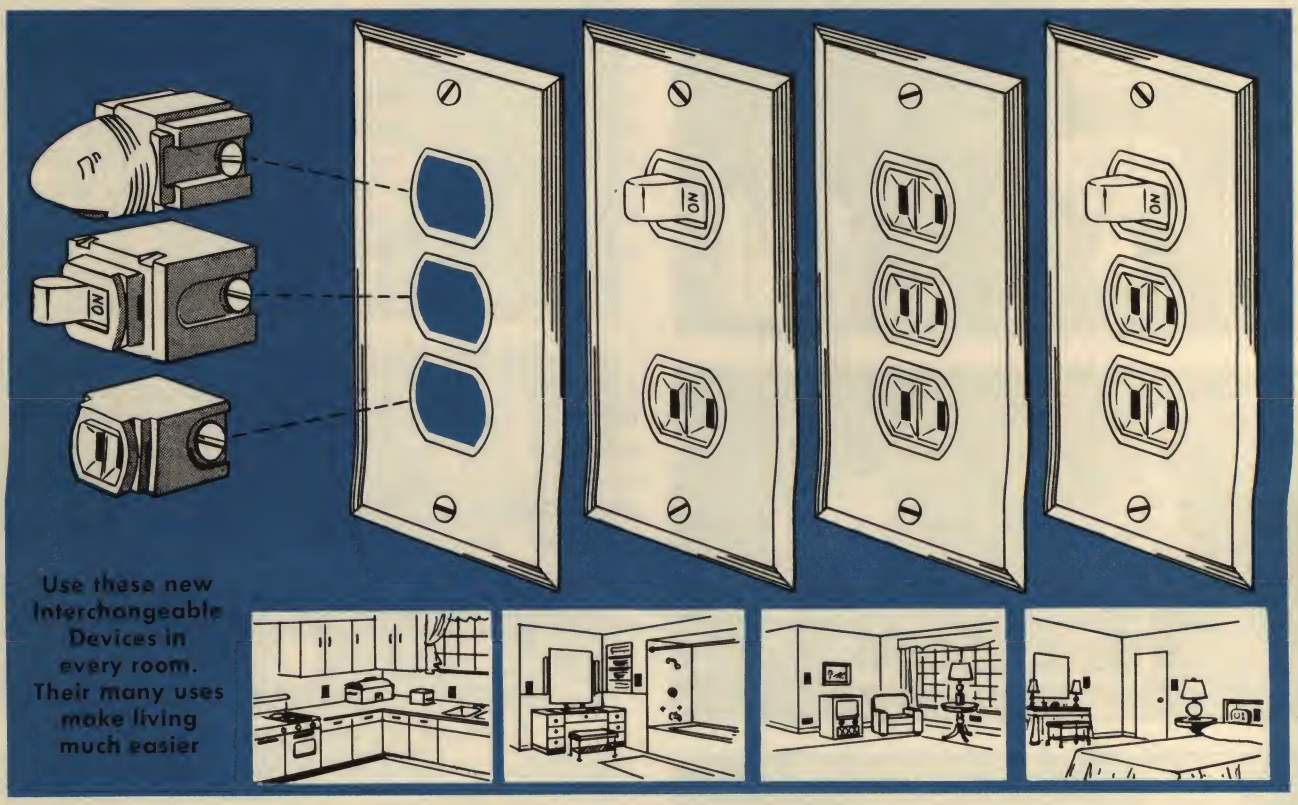


Installing one new ceiling outlet and two new switch outlets from existing ceiling outlet

Switches control lights independently. Connect black wire to black feed only at outlet on left and continue through outlet on right to switch, connecting to one terminal on each switch. White feed wire connects to the white fixture wire at outlet on left and connects to white fixture wire at outlet on right. The white wire at the switch box is connected to the other terminal on the switch at right and then connects to the other fixture wire at the outlet on right. Both ends of this wire from the switch must be painted black. Red wire at switch box connects to other terminal on switch at left then continues through outlet on right and connects to the other fixture wire at outlet on left.

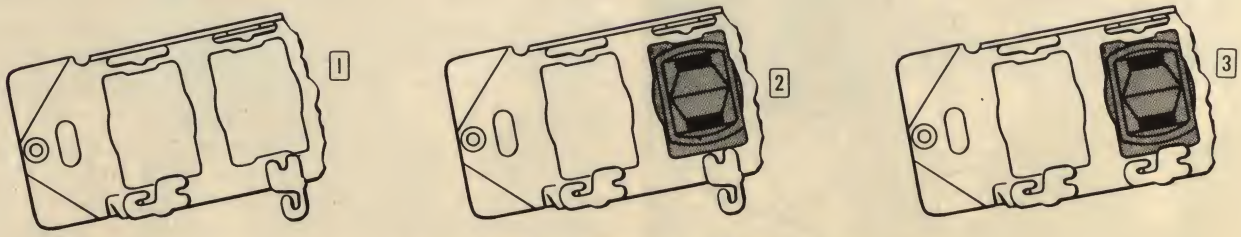
Interchangeable wiring devices and

The new-type outlet installation of many uses



These new devices offer many advantages—***The first*** being that a switch, outlet or pilot light, or any combination of one, two or three of these devices can be assembled into one combination in one standard-size box under one wall plate. This eliminates the installing of boxes in a "gang" (one, two or three) and making large openings and having large wall plates. ***The second advantage*** is that it gives a flexible operation and installation of the devices used in one box.

Two of the newer uses are the split-circuit wiring where two circuits are in one box. For easy identification and for balancing load of heavy appliances used in Kitchen, you can plug in an ivory-color receptacle at top on one circuit and plug in a brown receptacle at bottom on the other circuit. Another use is in living rooms or bedrooms where the floor lamp is plugged into upper outlet of a two-outlet receptacle and controlled by a switch at door so that when you enter the room the wall switch controls the upper outlet which turns on the floor lamp. In this same outlet the lower receptacle is not controlled by the switch, but permanently connected, so that a clock or TV set may be plugged in at any time. Upper and lower outlets are independent of each other. See opposite page for other combinations.



Devices Can Be Installed in 3 Easy Steps.
(1) Open small lock; (2) Insert the device; (3) Close lock.

diagrams showing how to connect them

Here are the steps for installing Interchangeable Devices. (1) There is a small mounting strip with each wall plate and the devices are inserted as shown on page 30. (2) The devices are then wired as shown below. When connecting, leave insulation on wires between connections. Sometimes a brass connector or "Jumper" is used to connect terminals. (3) Insert devices into a deep outlet box. Bring cable into top or bottom of box to furnish extra clearance.

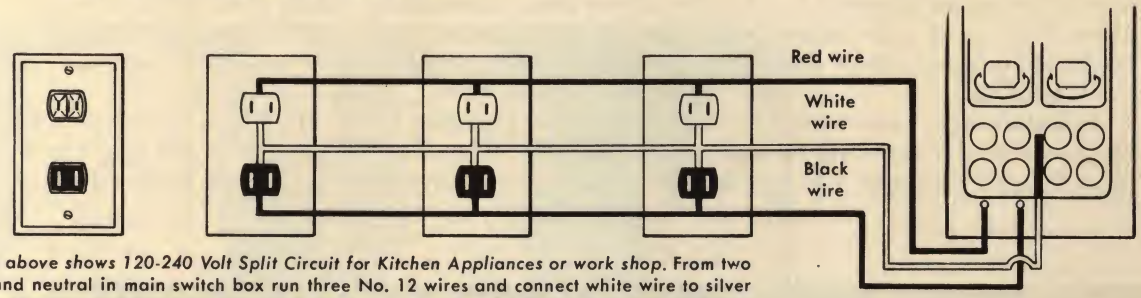
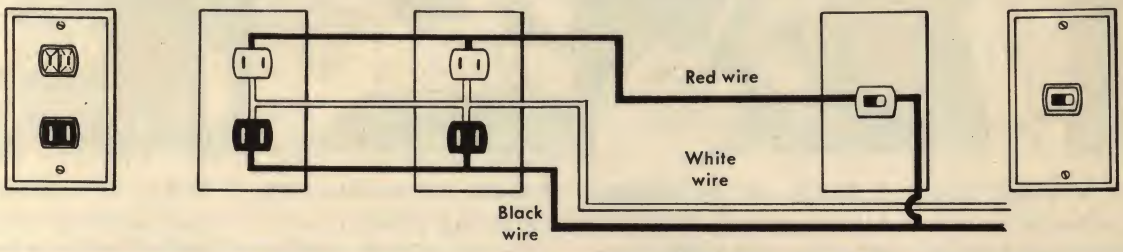
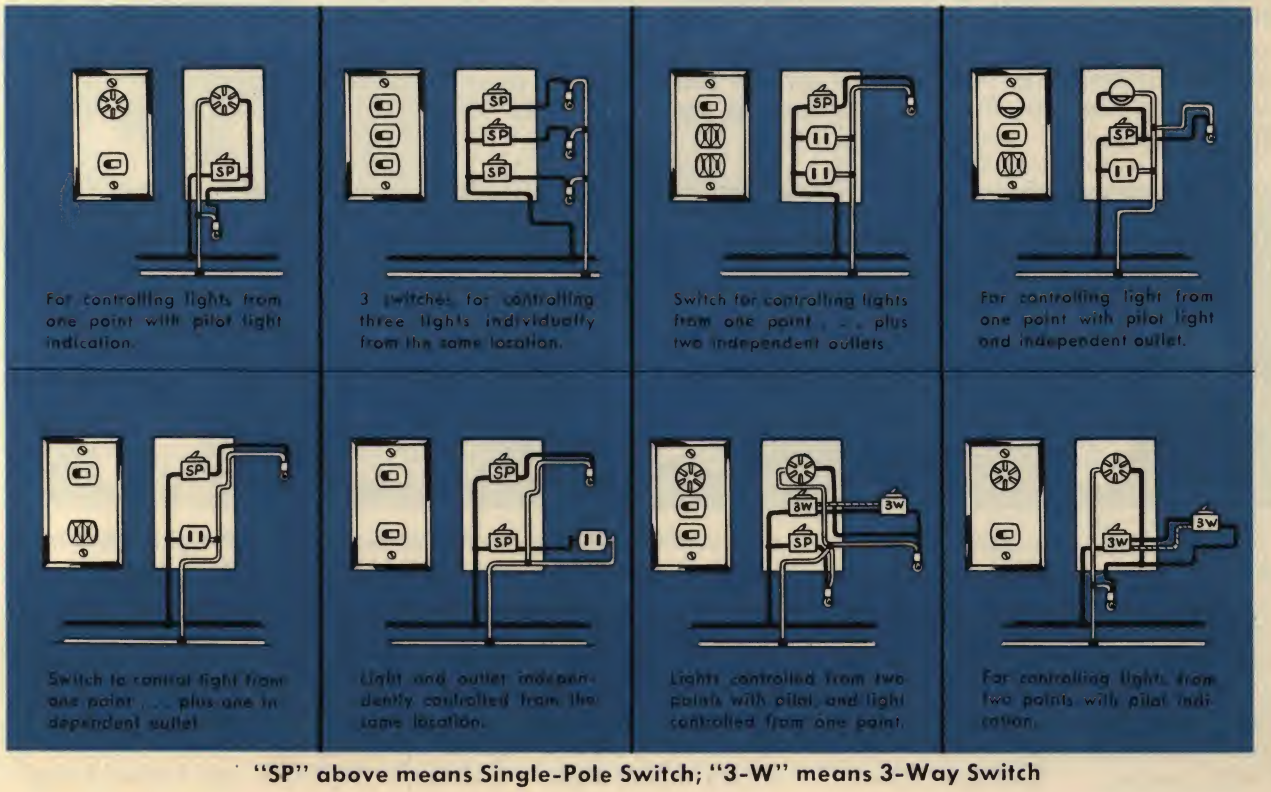


Diagram above shows 120-240 Volt Split Circuit for Kitchen Appliances or work shop. From two circuits and neutral in main switch box run three No. 12 wires and connect white wire to silver terminals of upper and lower receptacles. A common neutral is used. Connect red wire to brass-color terminal of top receptacles and black wire to brass-color terminal of bottom receptacles. This gives two circuits in one box.

Diagram below shows Split receptacles—upper half switch-controlled. In living room, from nearest outlet, run white (neutral) wire and connect to silver color terminals of upper and lower receptacles. Connect black wire to switch and brass-color terminals of lower outlets and red wire to brass-color terminal of upper outlets.



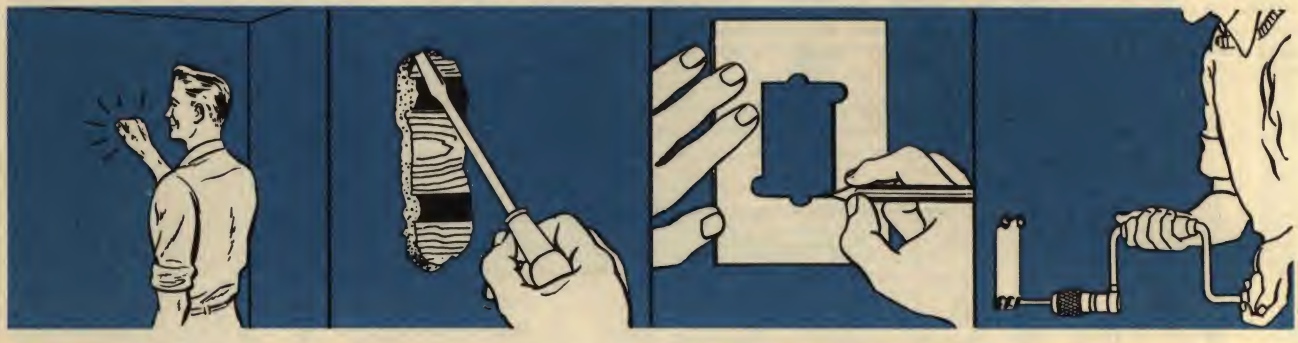


"SP" above means Single-Pole Switch; "3-W" means 3-Way Switch

PART 3 Methods of cutting plaster

Switch and outlet boxes must be located between the studs, preferably at a spot 4 to 5 inches from the stud. Be sure to place switches and outlets at correct height for convenience. Switches should be located about 48 to 54 inches above floor, convenience outlets about 12 to 18 inches above floor, or at table height in kitchen and dining room. Wall Light Fixture outlets should be 66 to 70 inches above floor. Always place switches at the opening side of a door, not on the hinged side.

Important note: Care should always be taken when punching knockouts. Punch only the knockouts you intend to run wires through, so that box will not have any hole unused at any time. Open holes in boxes represent a serious fire hazard and must always be plugged with knockout filler.



1. Sound for studs. You may be able to locate studs by sounding walls with hands. If not, drill every 2 inches until drill strikes stud. Drill just above baseboard so holes will not be noticed.

2. Notch out the plaster. After locating stud and selecting the right position for the box, notch away plaster as shown, so as to expose one full lath but only sections of top and bottom laths.

3. Outline Template. After chipping plaster as instructed at left, outline the position for the box, using Template from opposite page and a soft pencil. This will save time later.

4. Drill ½ inch holes. As soon as Template is outlined, bore four holes in wall (at positions indicated on Template) using a ½ inch bit. These holes provide space for a hacksaw.

5. Cut with Hacksaw. Apply cutting pressure as you draw blade toward you to avoid loosening plaster. Hold hand or board against plaster to prevent cracking.

6. Cutting the laths. When cutting openings ***do not cut away two full laths.*** You have a stronger mounting by cutting center lath completely and half sections from others.

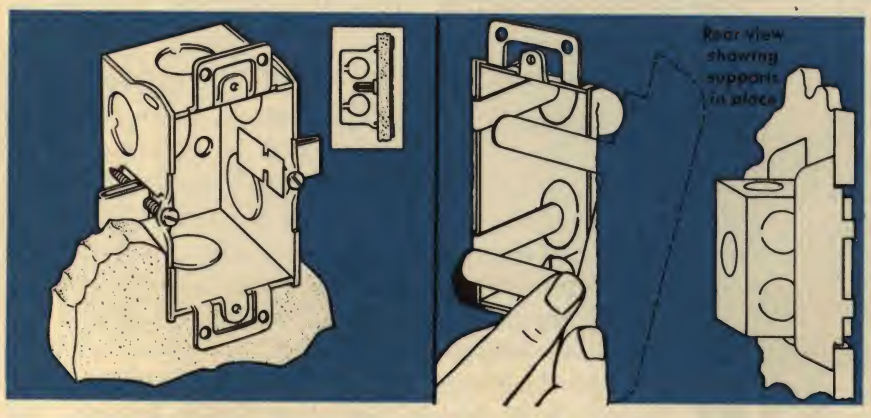
7. Insert box. Next step is to draw cable out of hole in wall, attach connector less locknut and pull lead wires through knockout and into box. Leave 8 inch length on lead wires.

8. Pull in connector. Pull on lead wires to bring connector into place. Note that Armored and Sheathed cable boxes are available also with built-in clamp for easier hook-up.

9. Tighten lock-nut. Next, screw locknut to connector and tighten as shown. The final step is always to anchor box securely to laths using No. 5 wood screws.

Installing outlets in old buildings

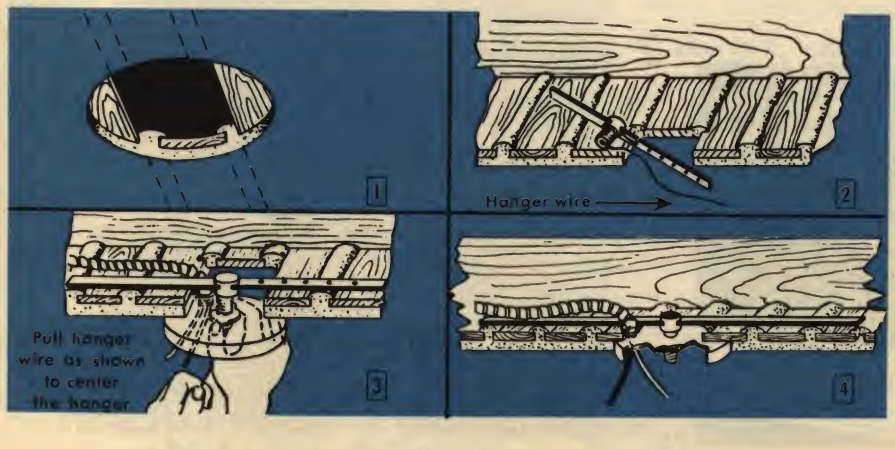
Boxes range in depth from 1½ to 2½ inches. Use large size when possible to allow plenty of room for wires. 1½-inch boxes are used only where space is limited. Use No. 5 wood screws, when anchoring box to wall. Adjust mounting brackets so that all edges are about 1/32-inch below level of plaster.



2 Easy Ways to mount boxes in OLD work

"Gem Dandy" type box clamps quickly and firmly in place. Illustration shows how easy it is to anchor securely both front and back. Place box with connected cable in opening so that front brackets fit against wall and side brackets are behind wall. Then tighten both side screws.

Metal box supports can assure a stronger installation. Insert supports to each side of box. Work supports up and down until they fit firmly against inside surface of wall . . . then bend projecting ears so they fit around walls of box.



How to mount ceiling boxes from below

Where space is not accessible from above the ceiling, the work must be done from below as indicated:

(1) Notch away plaster to size of a shallow box and carefully cut away center lath.

(2) Insert hanger (removing locknut and put wire thru threaded stud). Hold stud above the ceiling with one hand, pull wire with other hand and hanger will center itself.

(3) Connect cable to shallow box. Pull wire (from hanger) thru the center knockout and install locknut on threaded stud.

(4) View of completed installation.

Take time now to make this Template

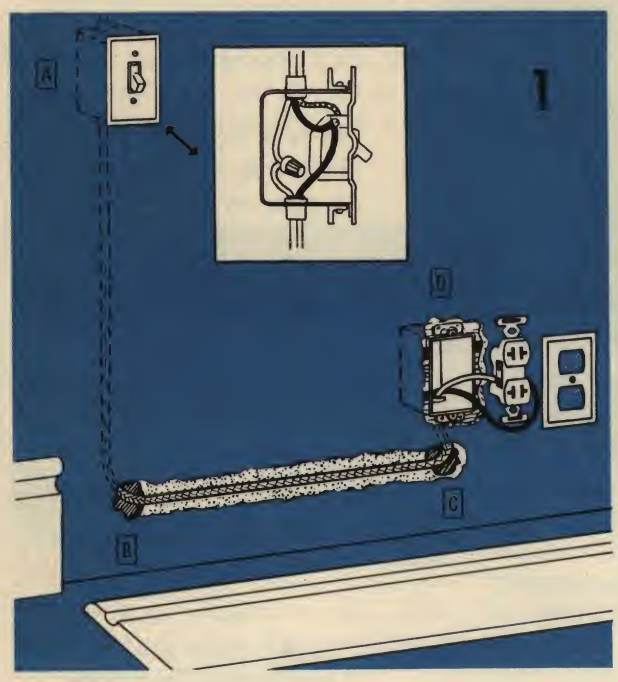
By using a Template you can saw through plaster and lath at the same time.

All you need to do is place Template against wall where you wish to install the metal box. Outline with a soft pencil the form of the Template. Drill four holes as outlined on Template. The center holes at top and bottom are to allow for screws used to fasten receptacle or switch to box. The two holes at sides allow clearance for screws that protrude over the box, and also provide opening for a hack saw blade.

How to cut plaster. Start to cut along outside edge of the pencil line. Note that you cut plaster and lath at the same time. When complete opening is made, test the box and you'll find that you have a snug fit.

Recommended methods of installing

Methods shown on these pages are for cases where you want all wiring kept concealed. Refer also to page 25 for information about EXPOSED wiring and use of new plastic cable that simplifies the job.



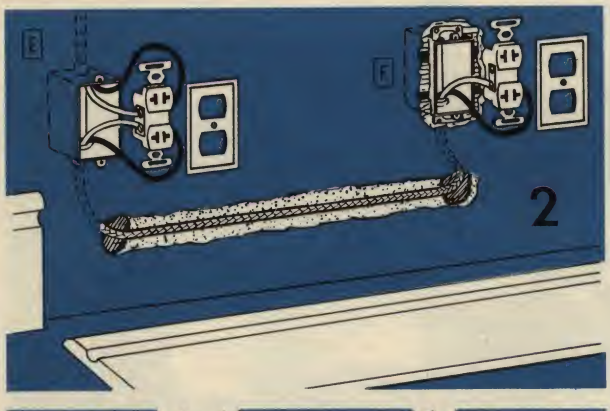
1 From wall switch to baseboard outlet

The method illustrated at left generally affords the easiest way of installing an additional convenience outlet. It can be used, however, only if there is a neutral wire available in switch box A or, if there is conduit from A to the ceiling outlet, in which case the neutral wire can be fished easily right through the conduit.

1st Step. Select location for the new receptacle and cut hole in wall as shown on page 32, then remove baseboard and cut holes B and C directly below switch A and receptacle D. Notch channel in plaster, between two laths, deep enough to accommodate cable. This makes it unnecessary to cut through studs.

2nd Step. Remove knockout in switch box A. Attach a connector to cable. Fish wire from A to B. Attach cable to fish tape and pull cable into knockout in A. Then run cable through hole C to box D.

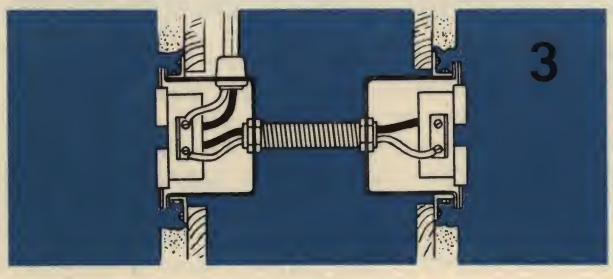
3rd Step. Connect cable wires at A and D as illustrated (black wire to dark-colored terminal of receptacle and white wire to light-colored terminal).



2 Wiring from one outlet to another

Preliminary steps for this installation are the same as illustrated and described above . . . remove baseboard and cut holes in wall where new or additional outlets are to be located. Then notch a channel in plaster for running cable along outside of wall, behind baseboard.

Next, cut a length of 2-wire cable long enough to extend from outlet box E to where new outlet box F is to be added. Place the cable in groove, and clamp securely to each outlet box. Connect wires within each outlet box as shown . . . the black wires to the dark-colored terminals, and the white wires to the light-colored terminals. When replacing baseboard be very careful that no nails are driven into the cable.

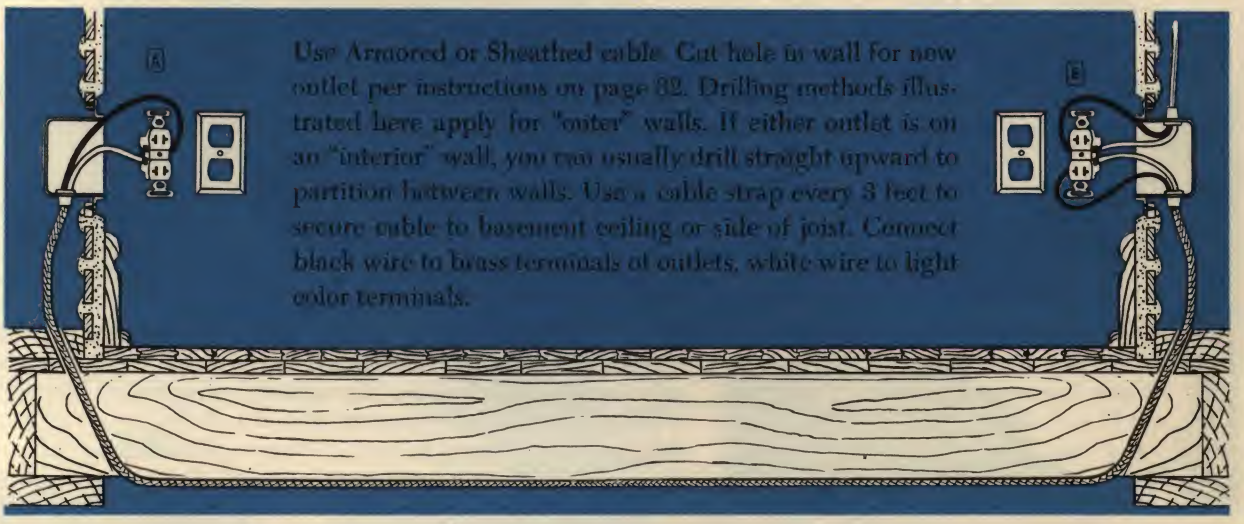


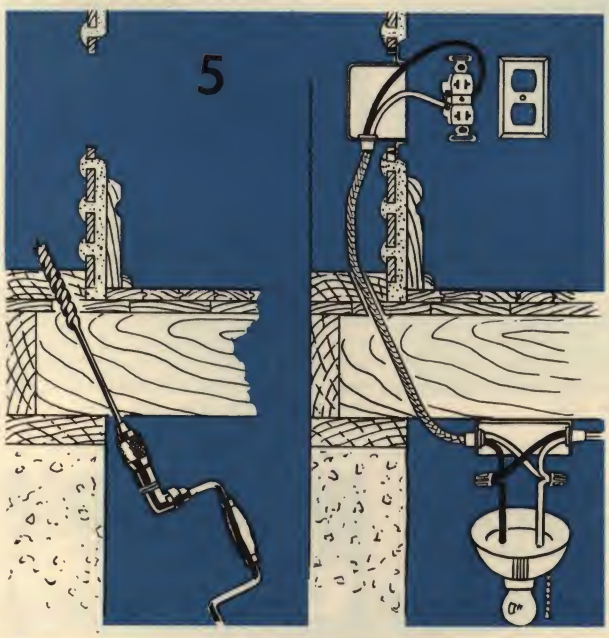
3 Wiring outlets in adjoining rooms

If outlets are to be located back-to-back in adjoining rooms, cut holes in walls of both rooms, opposite each other, and connect wiring from one receptacle to another using either conduit or a threaded nipple with locknuts.

additional outlets in old work

4 Wiring new outlet A from existing outlet B by drilling through floors and wiring across basement ceiling.





5 Wiring through floor from basement ceiling light to a first-floor outlet

Use either Armored or Sheathed cable in a continuous length from light outlet to baseboard outlet.

Step 1. Select location for outlet and prepare the opening . . . cutting through plaster and laths.

Step 2. If outlet is to be on an outer wall, bore a hole diagonally (as shown) through floor from basement upward, using long-shank bit. If outlet is to be on an interior wall you can usually bore through floor directly upward to partition between walls.

Step 3. By pushing a length of fish wire up hole from basement and attaching wires to it you can easily pull wires through to the outlet opening.

Step 4. Attach cable to boxes. Make connections as shown. Connect black wire to brass-color terminals of outlets, white wire to light-color terminals.

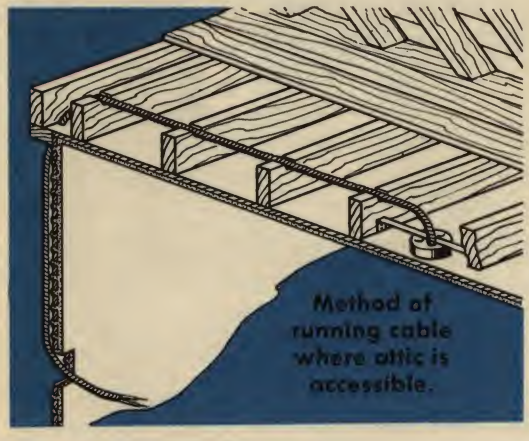
6 How to gang metal boxes

Switches and receptacles are mounted in the same kind of switch box. Metal switch boxes are constructed so that any number can be ganged. Sides of each box are removable so they can be fastened to each other.

The steps in joining boxes are as at left: **1.** Remove wall end of each box. **2.** Fit boxes together and tighten the screws. This applies only to metal boxes.

Methods used for fishing wires,

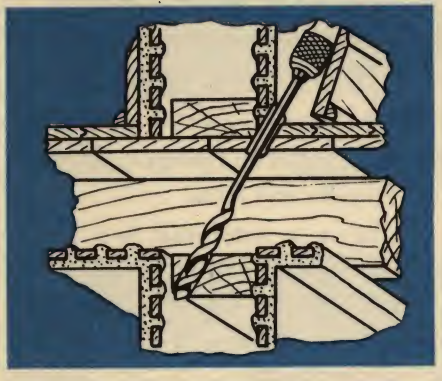
By "Old" Work we mean the wiring or re-wiring of a building already built. The most difficult problem is how to run cable inside walls and ceilings from one location to another. A little knowledge of carpentry and building construction as outlined on these pages makes the job easier. Non-metallic sheathed cable, dual-purpose plastic cable or armored cable should be used because these type wires can be drawn between walls, ceilings or floors without disturbing the construction.



Where attic is accessible, as shown at left, as in wiring one-story houses or second floors, the attic floor boards can be lifted, the joists notched and a hole bored with an electrician's bit through any obstruction. When replacing floor board be careful that you don't drive a nail through the cable.

Where attic is not accessible and cable can be run parallel with floor beams or joists, it becomes necessary to connect ceiling outlets with wall switches by bringing cable through the partition plate where wall meets ceiling and where there is usually an obstruction to block passage of the cable. After drilling the necessary opening through this obstruction by methods 1 and 2 shown at left, the next step is to draw the cable through this opening by using fish wire. Where cable must be run ***across floor beams,*** floor boards must be lifted. See opposite page.

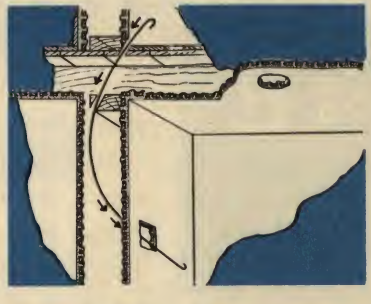
2 ways to drill



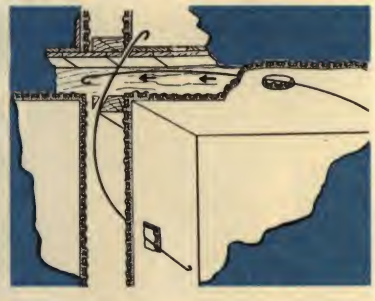
1. Remove baseboard on second floor, then drill diagonal hole downward as shown.

2. Drill diagonal hole upward from opposite room. Then drill horizontally until holes meet to provide opening for cable. This method requires patching plaster. Usually used where the drilling is done from a closet.

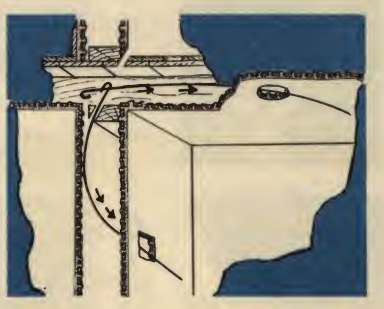
How to fish the wires



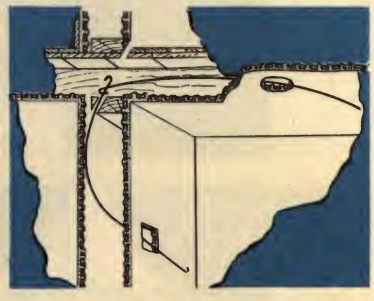
After drilling hole as instructed in Number 1 at left, use a fish wire (about 12 ft.) with hooks on both ends. Push through hole on second floor, pull end out at switch outlet on first floor.



Next push a fish wire (about 20 or 25 ft.) with wire hooks on both ends through the ceiling outlet as indicated above by arrows. Continue to fish until you make contact with the other fish wire.



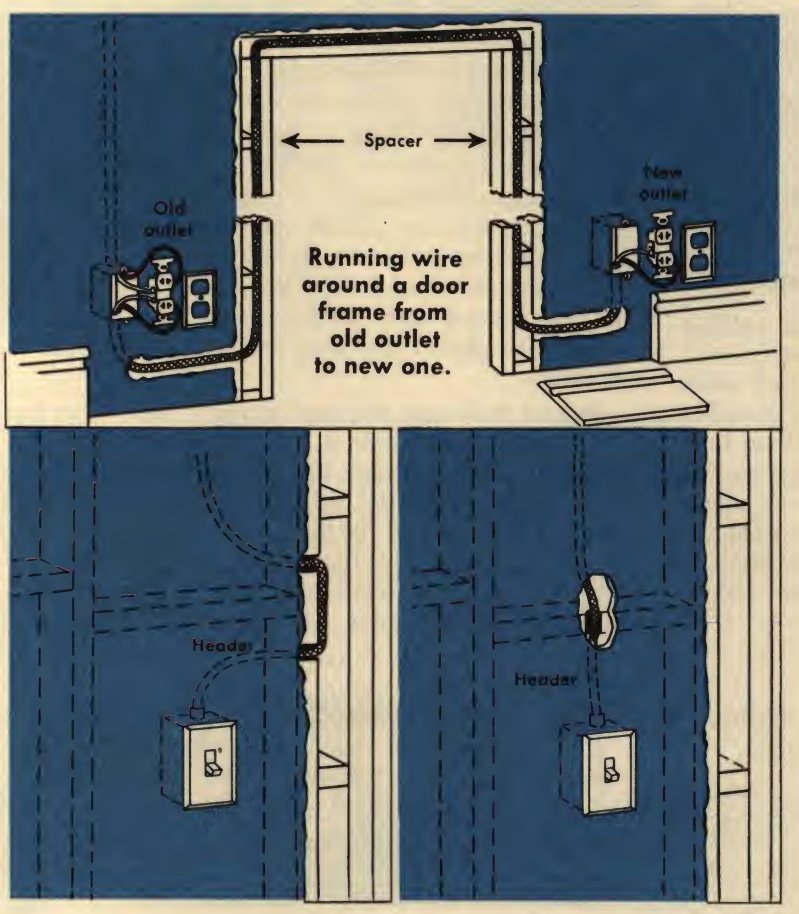
After the two fish wires touch, withdraw either fish wire as indicated by arrows until you have it hooked on the other fish wire; then withdraw the other wire until the hooks are hooked together.



Next pull the shorter fish wire through switch outlet until the hook from the other fish wire appears. To end of this wire attach a continuous length of cable and pull it thru wall and ceiling.

lifting floor boards in old work

To get around other obstructions such as door frames or headers within the walls, follow the methods outlined below. There are also those cases where a cable must be run at right angles across or through floor beams (joists), and beams must be notched or drilled from above, which requires that you lift sections of the flooring. This is a delicate operation which requires great care in order to avoid marring of floor boards. Note that cleats must be nailed to joists to help support floor boards before you replace them.

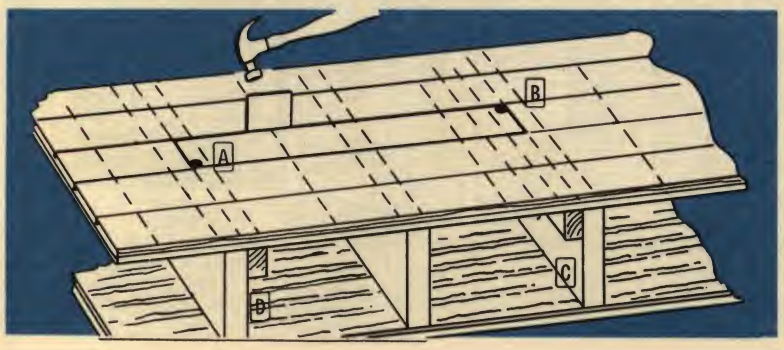


Going Around Header

If switch or outlet is to be next to door. Remove door stop, drill hole through door jamb and frame above and below header, notch door jamb to take cable.

Going Past Header

Alternate method is to notch out piece of plaster, lath and header from top to bottom as shown above. This method will require patching the plaster.



When installing cable around door from present outlet on one side to new outlet on other side. Easiest way is to remove base board and door trim as at left. Notch wall and spacers between door frame and jamb. When replacing door trim and baseboard be careful not to nail thru cable.

Headers are not always found in partitions. But if you should have a wall with headers the instructions for passing these are shown at left. However, if the outlet is to be located beyond the first upright from the door, use an extension bit to drill past the additional uprights.

How to lift floor boards

If joists run at right angles to cable to be installed: The illustration at bottom shows how to make a pocket so you can drill holes for cable through joists. To remove a finished floor board, use a heavy putty knife or scraper and insert between boards. Hit side of blade to cut tongue ***on each side of board to be removed.*** Drill ¼-inch hole at opposite corners of pocket (A and B), cut thru finished and rough floor boards using a keyhole saw, then remove. Before replacing floor be sure to install cleats (C and D).

An alternate method is to remove entire length of finished floor board. This is accomplished by starting at end of board to be removed and cutting tongue the entire length on each side. Pry up end with chisel, slip ½-inch pipe underneath board to remove it, or you can pry up board to exact length required and saw it off. If you have "sleepers" or furring strips between rough and finished floor just notch these to width of cable. Be careful not to nail thru cable when replacing board. If you have to go below rough floor, never remove flooring above bridging between joists.

Recommended methods of installing switches and outlets in new work

By "New" work we mean wiring for new buildings still in the process of construction. "New" work is much simpler than "old" work—it is just a matter of running wires to the various outlets and boxes along the most direct route, before plastering or interior finishing has been started.

In some localities, particularly urban areas, local regulations specify that all "new" work be done with conduit. The reason for using conduit, instead of Armored Cable or Non-metallic Sheathed Cable, is that conduit wiring is less liable to injury. Also, it is simpler later on, to do minor rewiring, because wires can be pulled out of the conduit and larger ones installed.

Installing conduit run. In "new" work the conduit run is put into place before house is completely built. Then, after house is finished and walls plastered, wires are run through conduit and connected to switches and outlets. See page 26 for information about handling conduit and connecting to boxes. When bending conduit make gradual bends. Abrupt bends might cause damage to the insulation of wires inside the conduit. Do not have more than four quarter bends in a run of conduit from one outlet to another. Otherwise, it will be difficult to insert wires.

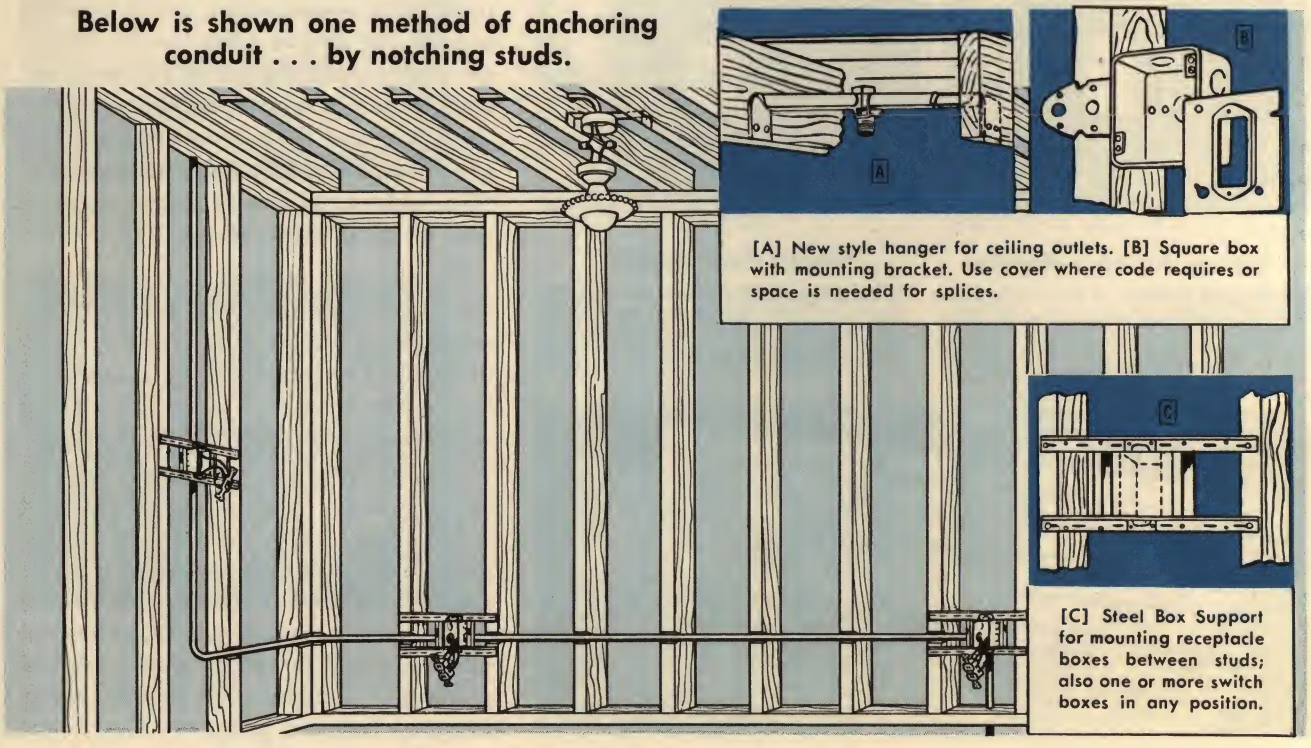
Anchoring conduit. Where conduit runs along the side of a stud or joist it should be supported every 6 to 8 feet with a pipe strap or clamp. Where conduit runs horizontally across wall studs or joists as shown below, cut notches to provide a channel for conduit. Many electricians prefer the method illustrated on opposite page because it does less damage to studs.

The final step. Wires should not be drawn through conduit until conduit is installed and plaster finished. Be sure that wires used in the system conform to color code . . . in a 2-wire circuit, one black, one white . . . in a 3-wire circuit, one black, one white, one red.

Wires must be continuous from outlet to outlet. Do not use spliced wires. Pull boxes or junction boxes shall be so placed that they are easily accessible at all times.

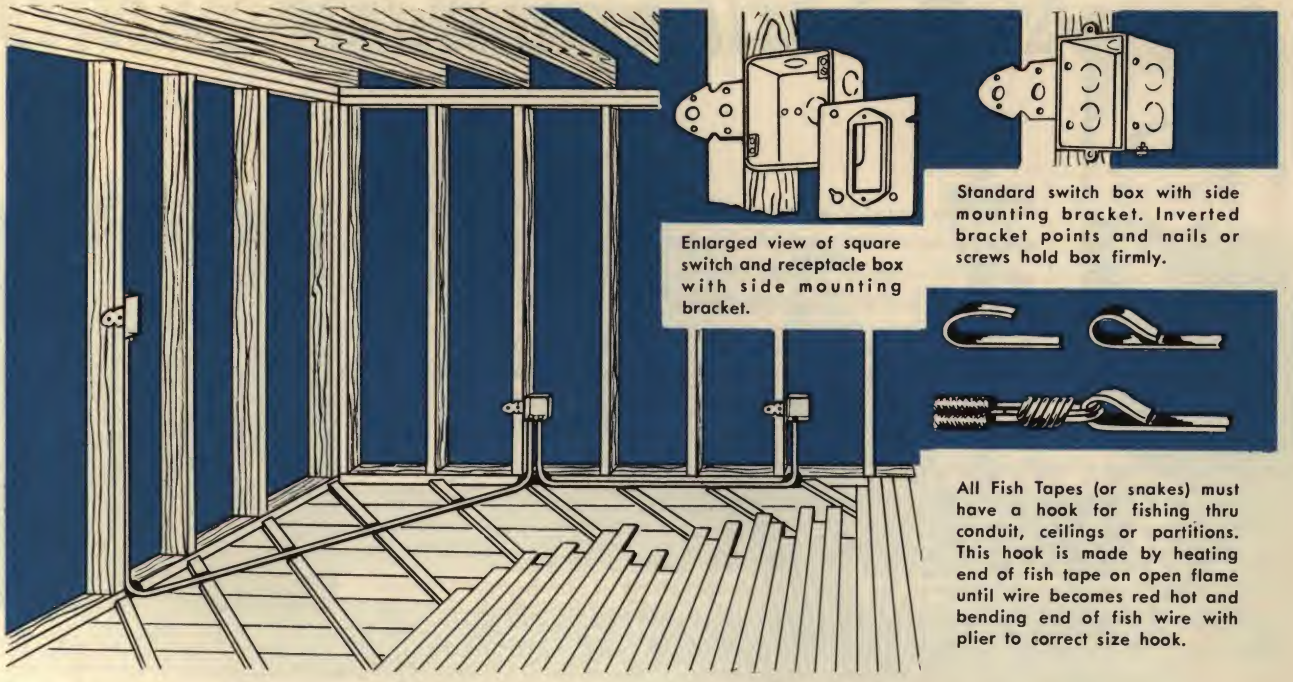
Use of fish tape. Where the run is short and has only one or two bends it is possible to push wires through conduit. Where the run is long and several wires are to be inserted, fish tape will be needed. Fish tape comes in 50 and 100 foot lengths. In straight runs tape moves smoothly, but where bends occur, drive fish tape back and forth until bend is passed. Soapstone or talcum powder may be used as a lubricant.

Below is shown one method of anchoring conduit . . . by notching studs.



[A] New style hanger for ceiling outlets. [B] Square box with mounting bracket. Use cover where code requires or space is needed for splices.

[C] Steel Box Support for mounting receptacle boxes between studs; also one or more switch boxes in any position.



Enlarged view of square switch and receptacle box with side mounting bracket.

Standard switch box with side mounting bracket. Inverted bracket points and nails or screws hold box firmly.

All Fish Tapes (or snakes) must have a hook for fishing thru conduit, ceilings or partitions. This hook is made by heating end of fish tape on open flame until wire becomes red hot and bending end of fish wire with plier to correct size hook.

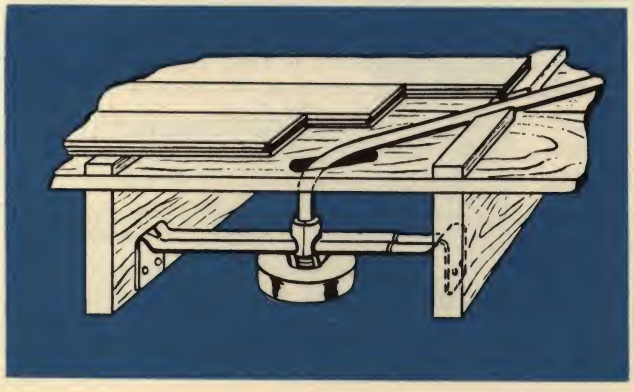
Installing conduit by running across sub-flooring

The above illustration shows how to install thin-wall conduit in new work without notching the upright studs. This type of installation is better because it will not weaken the supporting members of your ceiling and upstairs rooms, and it also eliminates considerable extra work. To install conduit all the carpentry that is necessary is a small notch in the plate where you have a conduit bend. Conduit is then laid across the rough floor. Furring strips (or sleepers) are then installed up to conduit as shown and then continued to rough wall. After all rooms are plastered or finished the finished flooring (or plywood where linoleum is installed) is then nailed to furring strips. It is also always advisable to cover the rough flooring with water-proof building paper.

Instructions for handling and bending of the conduit are included on page 26. Note also that the National Electric Code permits only four 90° bends in any run of conduit between any two boxes. See opposite page for instructions on how to fish wire through the conduit after walls have been plastered.

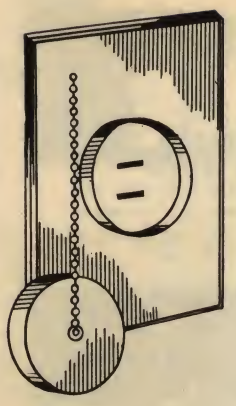
Wire capacities of conduit: The size conduit you use in any given run depends on the number of wires to be encased in it. See pages 20 and 26 for general information on this point, but it is also well to check your Local Electric Code as some local codes deviate from the National Code on this point.

When Mounting switch and outlet boxes be sure that edges of boxes are far enough out from the lath so that they can be lined up level with the plaster line. Also be sure that switch boxes are mounted so that there will be at least a 2-inch clearance from any door trim or frame.



Installation of ceiling outlets

The illustration on left shows how conduit is installed to a ceiling outlet (New work) where a finished floor is to be installed overhead. Drill 2 holes about 6 inches apart in line of direction of conduit. Cut out between holes with keyhole saw. This slot is necessary to accommodate the radius of the bend in the conduit. Use type of hanger shown and nail hanger to joists before connecting conduit. Be sure that outlet sets true and straight with bottom edge level with plaster line.



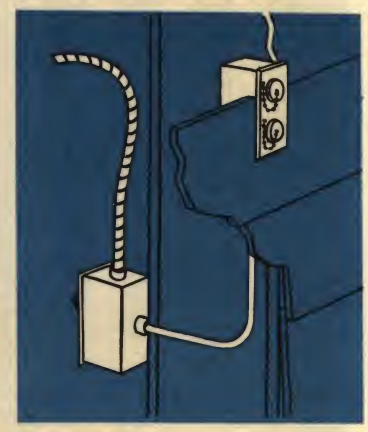
Installing outdoor outlets

With the trend toward outdoor living and with the many uses of electricity outside the home it is necessary to have plenty of outlets "where you want them." Here are some uses for electricity out-of-doors.

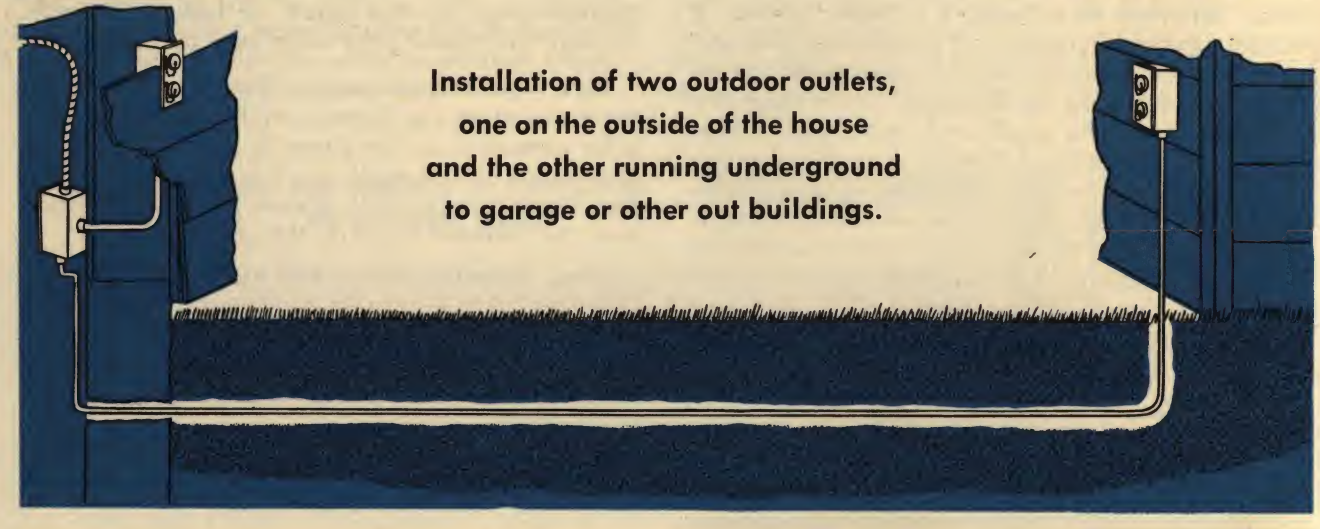
Patio and Garden Lighting	Portable Motors
Electric Mowers	Barbecues and Rotisseries
Electric Hedge Trimmers	Electric Spaders
Christmas Lighting	Electric Bug Trap

Outdoor Wiring is not essentially different from the indoor variety, except that weather and moisture have to be taken into consideration. The least expensive method in outdoor wiring to outlets and switches is an underground installation with dual-purpose plastic cable, described on opposite page.

A weather-proof outlet should be installed at the front of the house. Others should be located nearest to the point of normal use, so as to eliminate long extension cords. Besides installing weatherproof outlets and switches on the outer part of a house, it is also a good idea to install them at out-buildings, barns, garages, posts. Weatherproof outlets are available in the single and double-receptacle type, in addition to weatherproof switches. On farms when using heavy heating equipment or large motors, be certain you have the correct size wire for the distance you have to go and the size of the load you are going to plug in. See table on page 47.



Installing a single outdoor outlet by running wire from inside box through wall partitions.



Installation of two outdoor outlets, one on the outside of the house and the other running underground to garage or other out buildings.

It is best to bury the wiring two feet or more underground, to avoid injury from spading or digging. Better still, bury the wiring below the normal frost line, where it will not be affected by extremely cold weather. All wire and cable should be used in unbroken lengths, splices being made only in boxes designed for outdoor use. When mounting a weatherproof outlet, be certain it is above the "snow line."

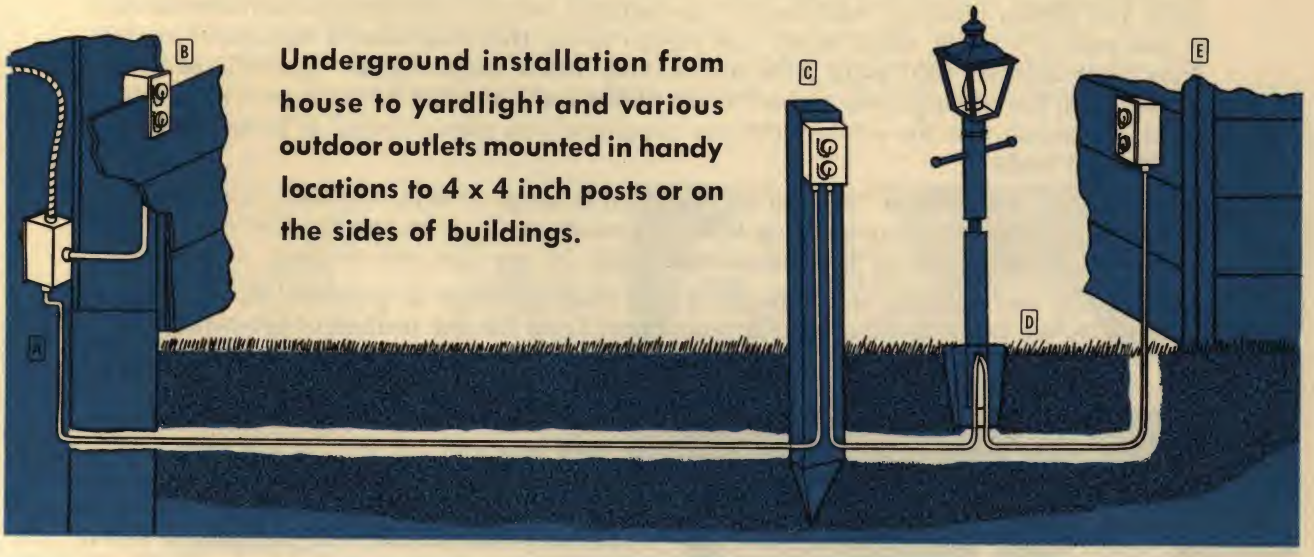
When an outlet is recessed (mounted into side of building as shown in left above), a standard outlet box is used with a special weatherproof outlet cover, which has a rubber gasket to keep out moisture.

When installing an outlet on the surface such as on a post or outer surface of a building, use a weatherproof outlet box and a weatherproof outlet cover.

After connecting to nearest source of power (outlet box shown at left inside house) in most cases it will be necessary to drill through a concrete foundation or cement block. Use a star or masonry drill.

After cable or conduit is installed, concrete or tar around cable at outer edge of wall to keep moisture from seeping through wall into basement.

for lights, mowers and barbecues



Underground installation from house to yardlight and various outdoor outlets mounted in handy locations to 4 x 4 inch posts or on the sides of buildings.

This is a typical installation which includes an outlet **[B]** on the back of your house, an outlet **[C]** on a 4 x 4 inch ground post, an outdoor yardlight **[D]**—which is switch-controlled in house and finally an outlet **[E]** on side of garage or other building. The wiring diagram for this would follow the same procedure as page 28, Figure 2, where you have a light controlled by switch and an outlet beyond the light. Two wires come into switch box at **[A]**. Run 2-wire cable from switch box **[A]** to connect receptacle **[B]**. Then run 3-wire cable from switch box **[A]** to outlet **[C]** on post and yardlight **[D]** as follows: White wire runs from switch **[A]** and is connected to post outlet **[C]**, then to yardlight **[D]** and to outlet **[E]** on side of building at right. Red wire is run from one terminal of switch **[A]** to post outlet box **[C]** but is not connected within box . . . just run direct to yardlight **[D]** as this is switch leg. Black wire is connected to other switch terminal at **[A]** and is connected to post outlet **[C]**. It is then run through the yardlight but is not connected to anything at the yardlight, but is connected to outlet **[E]** on side of building. Where wire runs into box and is not connected to outlet but continues to next outlet, join wires with solderless connectors. You can control light from house and the outlets will work independently from the switch. You can switch on Yardlight or plug in any lighting or appliances at any location.

New low-cost plastic cable for underground wiring

Be sure to check local Electric Code before doing underground wiring

The new type dual-purpose plastic cable described on page 25 makes underground wiring far less expensive and is far easier to install than the conduit method usually used. It is also less expensive than lead sheathing. It is particularly ideal for farms, when wiring from one building to another, as it gets the wiring out of the way of vehicles, where storms or high winds or falling trees cannot damage it. Will last indefinitely, as water, acids or alkalis cannot injure it. There is never any interruption to your electric service with a modern system of underground wiring.

In some localities the Local Code specifies that only Conduit or Lead-Sheathed Cable may be used for underground wiring. Be sure to check your Local Code.

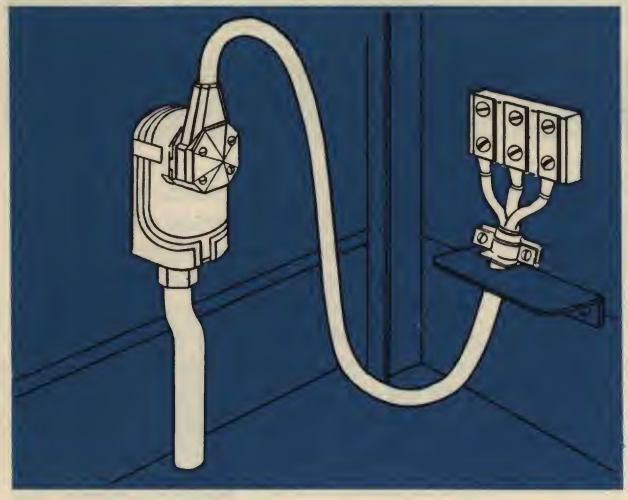
Plastic Cable can even be run through concrete or masonry walls.

Wiring ranges, dryers, water heaters

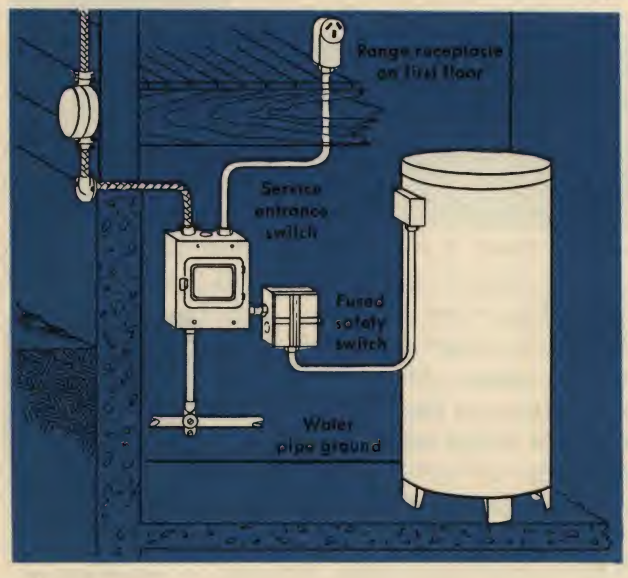
A separate 3-wire circuit must be installed for an electric range, electric water heater, electric dryer and certain room air conditioners. An entrance switch of 100 amperes is recommended to take care of a range, water heater and regular dryer. However, when a high speed electric dryer (approximately 8500 watts) is connected along with a range it is also generally necessary to have extra-heavy-gauge wire and extra heavy entrance equipment to take care of these appliances. Be certain that the service entrance equipment you plan to install is heavy enough to handle such loads.

A flexible 3-wire cord or "pig-tail" is connected to range or dryer terminals as shown. The other end of cord has a 3-prong plug to fit into range or dryer receptacle. Use of cord and receptacle permits range to be disconnected easily at any time for cleaning.

NOTE: Be sure that the metal frame of the range or dryer is grounded to the neutral terminal on the range or dryer. Check your Local Code for this method of grounding.



Typical Electric Range Installation or Electric Dryer Installation



Typical Hot Water Heater Installation

Electric Range—An electric range operates on 240 volts at high heat and 120 volts at low heat . . . therefore requiring a separate 3-wire No. 6 cable run from a 50 Amp. circuit in the main entrance box to a heavy-duty wall receptacle. Check with your REA or Power Company for type of wire specified by Local Electric Code. In many areas Service Entrance Cable is used and the uninsulated wire is connected to the neutral terminal on range receptacle.

High Speed Electric Dryer (approximately 8500 watts)—The method and materials used for the installation of this type dryer is the same as for range. The amperage capacity is about the same as a range.

Regular Electric Dryer (approximately 4200 watts)—This size dryer also uses 240 volts and 120 volts for the motor and light. It is necessary to run a separate circuit from a 30 Amp. pullout fuse or circuit breaker in the main entrance box or connect to the power takeoff lugs in the main entrance box, then connect to a fuse or circuit breaker safety switch and continue to dryer. A special heavy-duty wall receptacle is necessary.

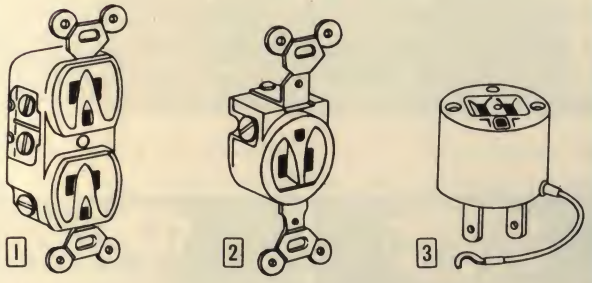
Water Heater Installation: Power Companies usually offer an unusually low rate for current used to heat water. This is called "Off-peak-load rate," and is offered during the hours when the demand for current is not great. The Power Company will install a separate meter and time switch which turns on or shuts off at certain hours of the day.

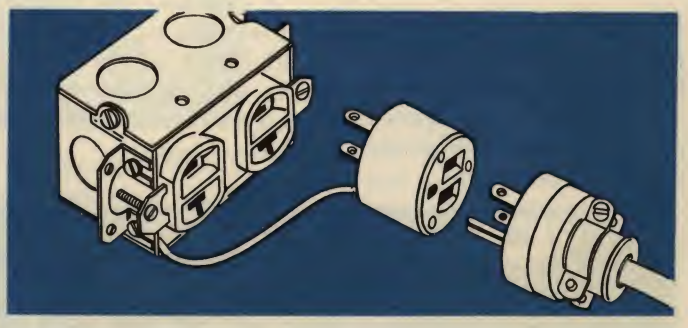
Types of Water Heaters: A double-element heater differs from the single-element type in that it permits a more constant supply of hot water. Double-element heaters have two thermostats. Single-element type has one thermostat. The size of elements, type of thermostats and method of wiring are usually specified by your Power Company or REA Cooperative.

Safety Switch: When Entrance Switch has an unfused tap for Water Heater, use an Indoor Safety Switch.

Polarized devices for laundry, kitchen

The devices below meet the new requirements of the Underwriters' Laboratories, Inc. Each has two current carrying contacts and one grounding contact. They help prevent accidental shock and guard against the dangers from current leakage due to faulty insulation and exposed wiring in motors and appliances. This is extremely important, in basements, work rooms and garages. Use on air conditioners, dryers, washers, freezers, portable tools, drills, extension lights.



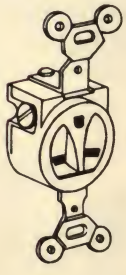


UL Approved 3-wire devices

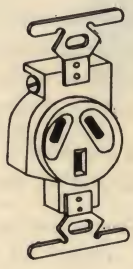
For equipment using ***120 Volts—15 Amperes or less,*** such as small Air Conditioners, Gas Dryers, Washers, Power Tools, Garden equipment, etc. **[1]** Duplex Receptacle with parallel Blade and U shaped ground. Fits standard switch box. **[2]** Single Receptacle with parallel blade and U shaped ground. Fits standard switch box. **[3]** Adapter for converting standard Receptacles to accommodate new style attachment cap with parallel Blade and U shaped ground. Also see view at right for hook-up to box.

Conversion from 2-wire to 3-wire

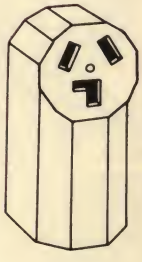
Here's how to convert a standard receptacle by using the adapter as shown above. If the wires which connect to outlet are run in conduit or armored cable connect the lug on the lead wire to one of the screws holding the receptacle to the box. If the wires are run in non-metallic cable which has a bare ground wire, connect the lug to this bare wire. If the wires are in non-metallic cable without a bare ground wire, be sure to connect the lug to a suitable ground such as a water pipe.



Single receptacle with tandem blades and U-shaped ground. Also available in duplex, but some areas will not permit a duplex receptacle of this type. For standard switch box and receptacle plate. For equipment using ***240 volts—15 amperes or less*** such as small air-conditioners, etc.



Single receptacle with crow-foot blade. Fits any standard switch box and uses a standard single receptacle plate. For use with equipment using ***240 volts—20 amperes or less,*** such as larger air conditioners, power tools, garden equipment, etc. Connect with 3 wire cable.



Surface-type receptacle with L shaped ground. Cord sets are available to complete the connection to standard dryers, etc., to permit easy disconnecting of dryer for cleaning and servicing. Connect with 3 wire cable. For equipment using ***240 volts—30 amperes or less.***

Surface-type receptacle. Cord sets are available in different lengths for connection to high-speed dryers, ranges, etc. Permits easy disconnection of equipment when redecorating, cleaning and servicing. Connect with 3 wire cable. For equipment using ***240 volts —50 amperes or less.***

Installation of lighting fixtures

No soldering or taping is required when Solderless Connectors (or Wire Nuts) are used. Simply hold ends of wires together and screw on the connector.

The installation of Lighting Fixtures consists ot two main steps, as follows:

1. *Fastening the fixture wires to the house wires.* First disconnect the current by pulling the main switch to the "off" position or by unscrewing fuse which controls that particular circuit. Then fasten black fixture wires to black wire in outlet box and white fixture wires (or the wires with a colored tracer) to white wire in the box.

2. *Fastening the fixture to the outlet box.* Various methods are shown. Except for recessed types they usually consist of first fastening the metal strap, included with fixture, to the threaded stud in the outlet box, or to the ears of the box, and then fastening the fixture to the strap by means of capnuts or locknuts. The design of certain fixtures eliminates the strap but, in other respects, the principle is identical.

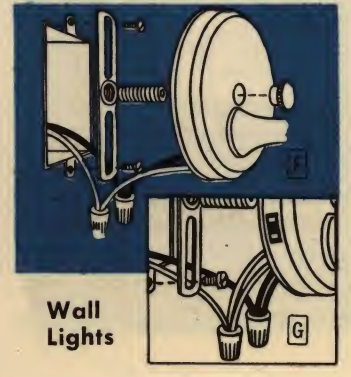
A method often used for installing Large Drop Fixtures.

Attaching ceiling or drop fixtures to stud in Outlet Box.

Attaching ceiling or drop fixtures to Ears of Outlet Box.

Installing Ceiling "Pan" fixtures to Stud in Outlet Box.

Installing "Pan" fixtures to Ears of Box.



Wall Lights

[A] One method of mounting frequently used in large drop fixtures. Screw hanger support onto thread stud in the outlet box. Connect wires, then raise canopy and anchor in position by means of locknut.

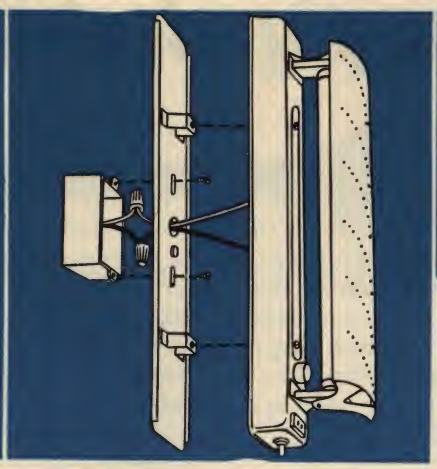
[B] Insert machine screws in threaded holes of metal strap as indicated by dotted lines. Slip center hole of strap over the stud in box and hold in position by locknut. After wires are connected, slip holes in canopy over the two machine screws adjusted so canopy will fit flush, and secure it with two cap nuts.

[C] This method is used when there is no threaded stud in box. It is identical to **[B]**, except that strap is fastened to ears of the box.

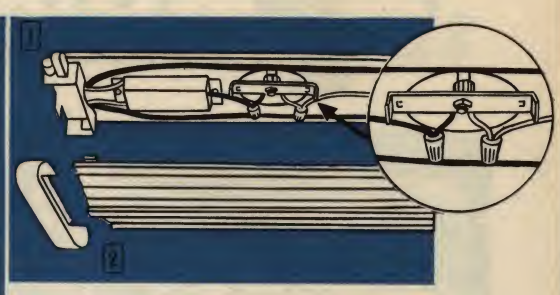
[D, E] Glass enclosed ceiling fixtures can be attached in either of these two ways. **[D]** applies when there is a stud provided in the outlet box. Attach brass adapter or cap to stud; then connect wires; then insert threaded nipple through the center hole in the fixture and screw into adapter until tight. Then fasten fixture with lock-nut. **[E]** The threaded nipple on light fixture is secured to a strap which has first been fastened to the ears of box.

[F, G] Most Wall Lights, either for interior or for exterior use, are installed by first fastening a metal strap to the ears of the box, and then, by means of a threaded nipple and cap nut, the Light Fixture itself is secured to the strap. Some Wall Lights also have an "always on" convenience outlet mounted in them. In such cases, the electrical connection is made, as shown in **[G]**, by fastening the white wire from the socket and the white wire from the outlet to the white wire in the outlet box and, similarly, both black wires in the Light Fixture to the black wire of the outlet box.

Circline fixture above consists of a top "pan" (1) which contains the ballast and sockets and a second piece (2) which covers the mounting screws. A metal strap is fastened either to the threaded stud or to ears of outlet box; after connecting wires the top "pan" is slipped over the machine screws in the strap and secured by capnuts. The cover is then secured and bulb inserted.

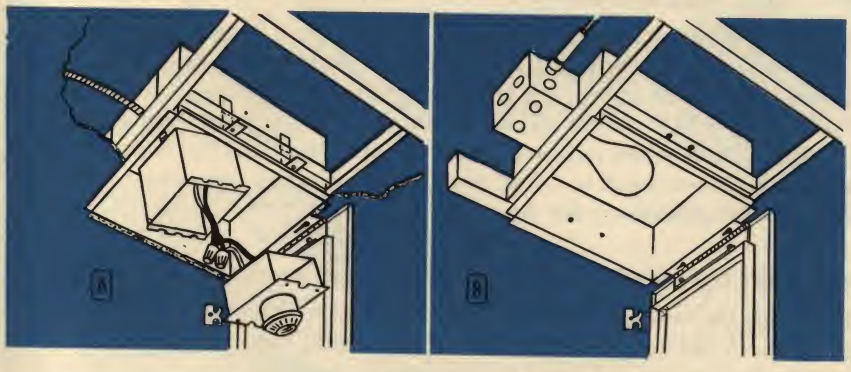


Fluorescent Wall Brackets do not usually require a separate strap. The back cover-plate comes pierced with holes spaced to match ears of the outlet. The bracket is first disassembled, wiring connections made, and back cover fastened to the box with 6/32 machine screws. Outer front shell of the bracket is then secured to back cover by screws included with the fixture.



Installation of Fluorescent Fixtures

Fluorescent Ceiling fixtures usually are made up of a chassis (1) to which are mounted the sockets, ballast and wiring. Over the chassis is a metal cover, (2) which is removed to mount fixture. To mount fixture, place chassis over outlet box so that the stud in the outlet box extends through the outer hole of the chassis. Fasten with locknut. If stud is not long enough use an extension nipple. Connect wires . . . black to black, white to white.



Recessed fixtures in OLD and NEW work

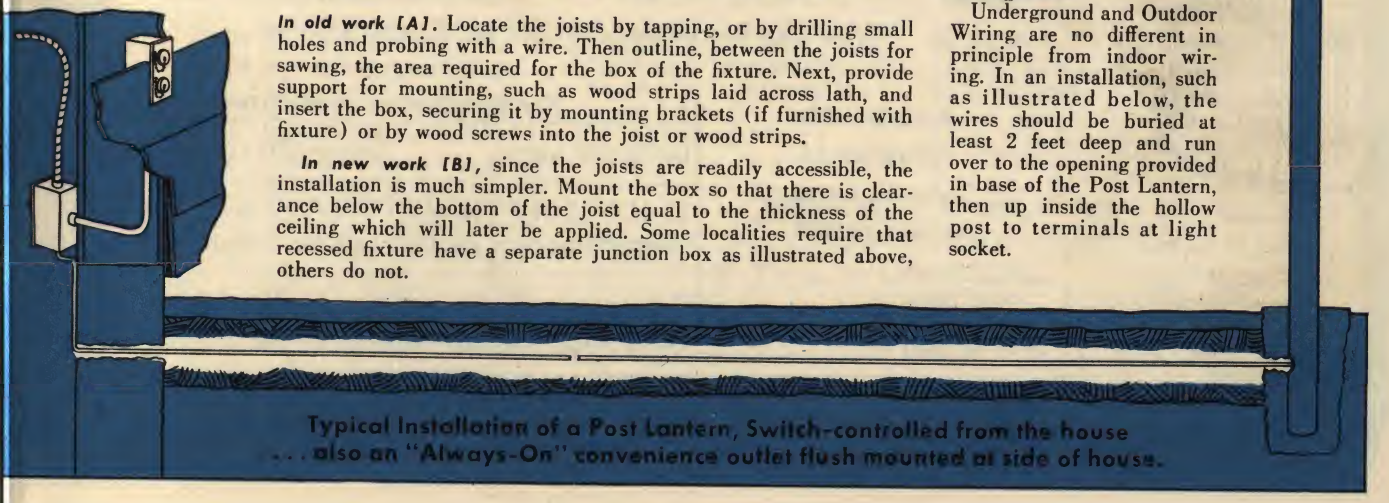
In old work [A]. Locate the joists by tapping, or by drilling small holes and probing with a wire. Then outline, between the joists for sawing, the area required for the box of the fixture. Next, provide support for mounting, such as wood strips laid across lath, and insert the box, securing it by mounting brackets (if furnished with fixture) or by wood screws into the joist or wood strips.

In new work [B], since the joists are readily accessible, the installation is much simpler. Mount the box so that there is clearance below the bottom of the joist equal to the thickness of the ceiling which will later be applied. Some localities require that recessed fixture have a separate junction box as illustrated above, others do not.

Installation of Yard lights

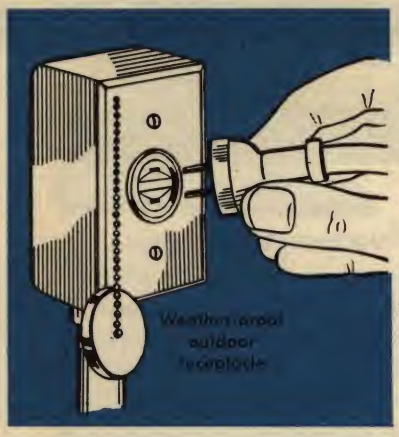
Lead-covered cable can usually be used underground but some Local Codes stipulate that this cable must be encased in conduit as extra protection against injury from garden tools. The most inexpensive and easiest of all methods, however, is the new dual-purpose plastic cable which is just as efficient and long lasting, provided your Local Code permits its use underground.

Underground and Outdoor Wiring are no different in principle from indoor wiring. In an installation, such as illustrated below, the wires should be buried at least 2 feet deep and run over to the opening provided in base of the Post Lantern, then up inside the hollow post to terminals at light socket.



Typical Installation of a Post Lantern, Switch-controlled from the house . . . also an "Always-On" convenience outlet flush mounted at side of house.

Providing for electric motors



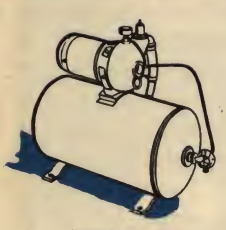
The number of electric motors you intend to use and their sizes are factors that must be considered in your plans for the future. In future years more and more of the work about the up-to-date farm, garage or shop will be done by electric motors. They possess more reserve power than gasoline motors, absorb temporary overloads better and need fewer repairs.

Be sure you provide a sufficient number of outlets for such motors to do heavy-duty jobs such as grinding feed, operating big ventilating fans, pumping water, welding, drying hay or hoisting. Outlets for heavy-duty work should always be on 240-volt circuits to avoid expensive waste of power and the annoyance of overloaded lines.

Heavy jobs demand larger motors for economy and efficiency

Most electric motors will stand overloads up to 200% for short periods of time or while starting, but continuous overloading of a motor can cause damage. Be sure the motor you use has sufficient horsepower for the job. Dont' try to get a steady 2 H.P. load from a motor rated at only 1 H.P.

For safety, switches for starting and emergency stopping of motors should be installed in the most accessible locations. If extension cords are used for short runs be sure they are No. 14 wire or heavier. Never use ordinary lamp cords for a motor. See opposite page for other information about cords.



Water system

Large Motors require 240-volt service to reduce voltage drop

Generally any electric motor of less than ½ H.P. can be powered from a 120-volt outlet, but 240-volt service should be provided for any motor rated ½ H.P. or above. On 240 volts a ½ H.P. motor draws 3½ amps., a 1 H.P. motor draws 5.5 amps., a 2 H.P. motor draws 10 amps. and a 3 H.P. motor draws 14 amps. Be sure your wiring is heavy enough to carry these loads when required. Distance of motor from the main entrance switch should also be considered to avoid voltage drops which can cause motor to labor and overheat. See table below for wire sizes.

Power saw

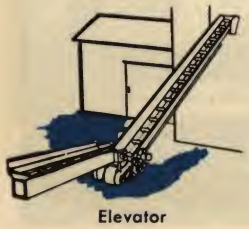
How to find the correct size wire needed for each size motor

In order to determine the correct size wire for permanent and portable motors, check the following: 1—Check the distance from the main switch to the motor. 2—Next check size of motor you intend to use. 3—Check table below to determine size wire you need.

Milk cooler

Wire Size Recommendations for Electric Motors

Measure the distance of motor from main switch	*Recommended Wire Sizes*					
	Using 120 volts		*Using 240 volts*			
	¼ H.P. motor	*½ H.P. motor*	*¾ H.P. motor*	*1 H.P. motor*	*3 H.P. motor*	*5 H.P. motor*
Up to 100 ft.	No. 14	No. 14	No. 14	No. 14	No. 12	No. 10
100 to 200 ft.	No. 12	No. 10	No. 14	No. 12	No. 10	No. 8
200 to 300 ft.	No. 10	No. 8	No. 12	No. 12	No. 8	No. 6
300 to 400 ft.	No. 8	No. 6	No. 10	No. 10	No. 6	No. 4
400 to 1000 ft.	.....	.....	.....	.....	No. 4	No. 2



Elevator

Correct safe use of extension cords

Select the Right Size and Type For Each Type of Job

No. 16 extension cord or No. 18 extension cord are usually adequate for lamps or smaller household appliances. But when used to operate heavy electric motors or other high-wattage appliances, the extension cord must be heavy enough to carry a much larger electrical load. Overloaded cords overheat, waste current and often fail to deliver sufficient power to run motors at top efficiency.

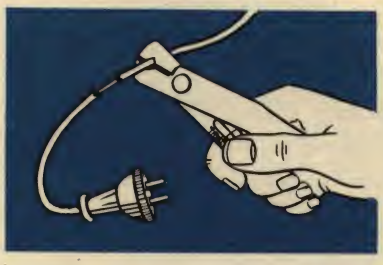
The Meaning of "Voltage Drop"

Every size of wire has its maximum allowable current carrying capacity as shown in table below, but the longer the length of cord used the greater the current loss or voltage drop. Long runs of cord are wasteful of current and seriously reduce the efficiency of the appliance being used. That's why it is always a good idea to plan your wiring system with plenty of outlets in convenient locations to provide for easy plug-in of all appliances.

What to do about damaged cords

Much cord trouble results from rough handling or careless usage such as jerking on the cord instead of grasping the plug when disconnecting from the receptacle. This practice can loosen connections or even break the wires.

Damaged cords are a fire hazard and should be repaired or replaced immediately to prevent short circuits and blown fuses. If cord has become frayed in several places, throw it away and replace it. If frayed or damaged only at one end, it can usually be repaired per instructions below. Sometimes a cord will appear to be in good condition but will not work. This may mean a broken wire at some point inside the outer cover. See page 60 for instructions in this case. Or it may simply mean that one or both of the wires have slipped from under the terminal screws, or the prongs may have been accidently bent so that they no longer make contact with the terminals.



How to repair cord by removing damaged piece

Wherever a cord is damaged or broken close to either end, just cut the wires and outer cover as shown. Then disconnect plug from the damaged piece of cord and connect terminals to salvaged cord. Round attachment plugs usually provide enough space for the use of Underwriters' Knot to help secure the wires. See page 60.

Types and usage of extension cords

	Type	Wire Size	Use
Ordinary Lamp Cord	POSJ POT	No. 16 or 18	In residences for lamps or small appliances.
Heavy-duty—with thicker covering	S or SJ	No. 10, 12, 14 or 16	In shops, and outdoors for larger motors, lawn mowers, outdoor lighting, etc.

Ability of cord to carry current (2 or 3 wire cord)

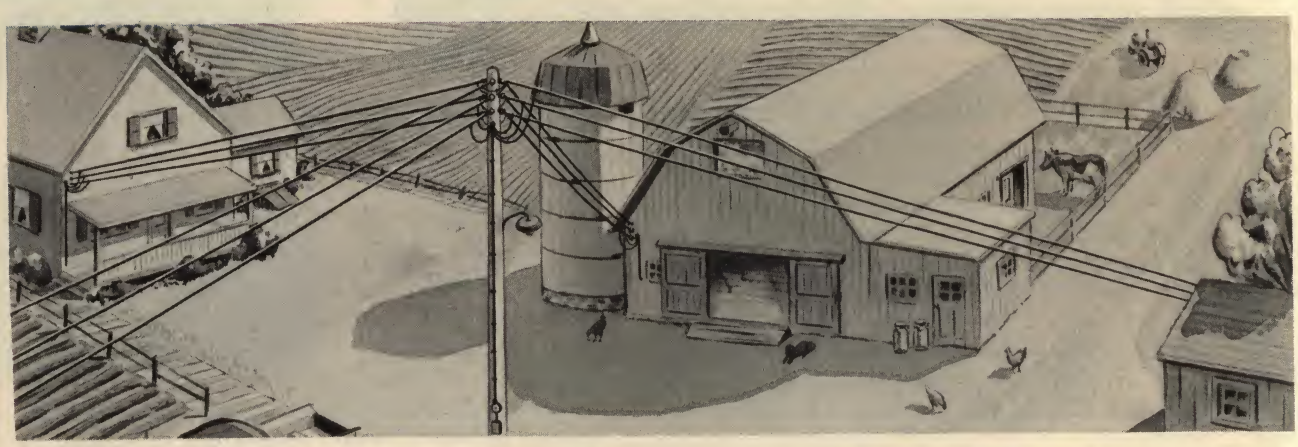
Wire Size	Type	Normal Load	Capacity Load
No. 18	S, SJ or POSJ	5.0 Amp. (600W)	7 Amp. (840W)
No. 16	S, SJ or POSJ	8.3 Amp. (1000W)	10 Amp. (1200W)
No. 14	S	12.5 Amp. (1500W)	15 Amp. (1800W)
No. 12	S	16.6 Amp. (1900W)	20 Amp. (2400W)

Selecting the length of wire

Light Load (to 7 amps.)	Medium Load (7-10 amps.)	Heavy Load (10-15 Amps.)
To 15 Ft.—Use No. 18	To 15 Ft.—Use No. 16	To 15 Ft.—Use No. 14
To 25 Ft.—Use No. 16	To 25 Ft.—Use No. 14	To 25 Ft.—Use No. 12
To 35 Ft.—Use No. 14		To 45 Ft.—Use No. 10

NOTE: As a safety precaution be sure to use only cords which are listed by Underwriters' Laboratories. Look for the Underwriters' seal when you buy.

PART 4 Wiring from yardpole



The yardpole is the central distribution panel for feeder wires to all buildings. Your Power Company or local REA will advise you as to the best location, and will usually set up the pole and install all wiring into the meter, which is usually installed on the pole.

Change-over of Existing Service Entrance — On many farms the service entrance equipment serving the entire farm was originally run into the house, then feeder lines went to the barn and other outbuildings. In such cases, the last building served usually has very low voltage, because of the distance of the run from the meter. This can be corrected with a yardpole and load-center distribution, which assures that no building is too far away from the main service. You may have a yardpole already, but with too small a service entrance. If so, check your Power Company or REA.

We recommend a separate three-wire feeder to each major building. Plan to have the correct size service entrance wires (see pages 10-11), to a minimum of 100-ampere, 150-ampere or 200-ampere main disconnect switch on yardpole. Then run three wires to a 60-ampere or 100-ampere subpanel at the house, three wires to a 60-ampere subpanel at barn, and three wires to a 30-ampere subpanel at the machine shed or shop. In certain cases it is acceptable to wire a small building from another where only lights or very small appliances will be used. (See page 55.)

Size of Feeder Wires—Wires must always be heavy enough to withstand ice, winds and weather. The Code specifies nothing smaller than No. 10 wire up to 50 feet, nothing smaller than No. 8 over 50 feet.

To determine the right size wires to each building, you must know (1) the length of run from yardpole to each building, (2) approximate amperage to be used in that building at one time. (To find amperage, divide wattage by voltage.) Select feeder sizes from table at upper right, entrance and interior wiring from table at right.

Adequate Wire Sizes— Weatherproof Copper Wire

Load in Building Amperes	*Distance in Feet from Pole to Building*	**Recommended Size of Feeder Wire for job*
Up to 25 amperes, 120 volts	Up to 50 feet	No. 10
	50 to 80 feet	No. 8
	80 to 125 feet	No. 6
20 to 30 amperes, 240 volts	Up to 80 feet	No. 10
	80 to 125 feet	No. 8
	125 to 200 feet	No. 6
	200 to 350 feet	No. 4
30 to 50 amperes, 240 volts	Up to 80 feet	No. 8
	80 to 125 feet	No. 6
	125 to 200 feet	No. 4
	200 to 300 feet	No. 2
	300 to 400 feet	No. 1

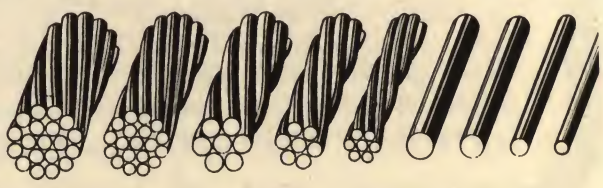
*These sizes are recommended to reduce "voltage drop" to a minimum.

Current-Carrying Capacities of Copper Wires

Current-Carrying Capacity in Amperes

Wire size	*In Raceway or Cable* — *Rubber*		*In Free Air* — *Rubber*		*Weather-proof Wire*
	*Type RH**	*Type TW, R**	*Type RH**	*Type TW, R**	
14	15	15	20	20	30
12	20	20	25	25	40
10	30	30	40	40	55
8	45	40	65	55	70
6	65	55	95	80	100
4	85	70	125	105	130
2	115	95	170	140	175
1	130	110	195	165	205
0	150	125	230	195	235

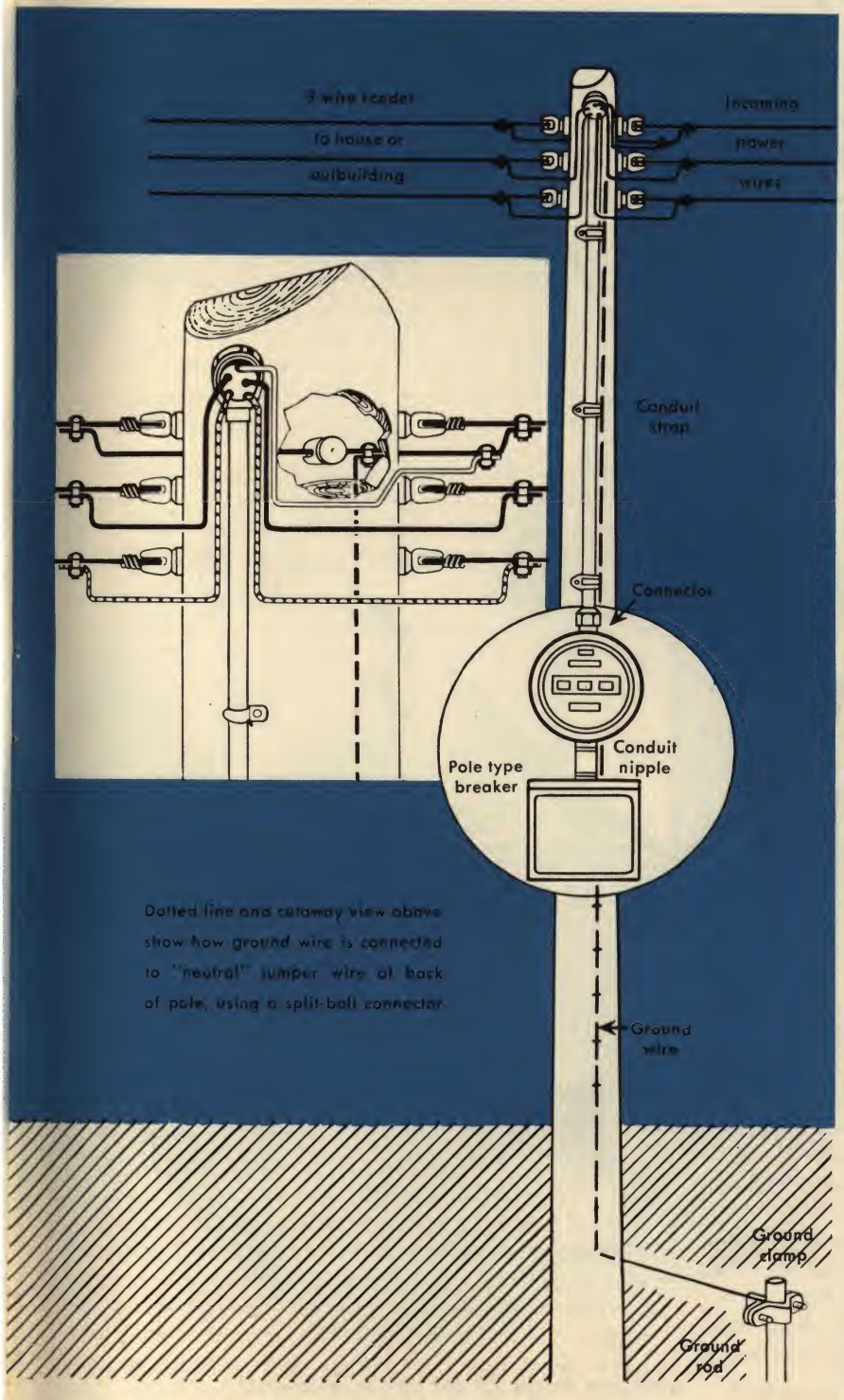
*Types "RH", "TW", or "R" are identified by markings on outer cover.



0 1 2 4 6 8 10 12 14

Actual size of copper conductors. Note the larger the gauge number the smaller the diameter of the wire.

to house, barn and outbuildings



Wiring the Yardpole

Two separate wiring systems meet at the Yardpole . . . [1] the power wires which bring in electricity from the Hi-line to the meter and [2] the feeder wires which distribute the metered electricity to the buildings. Illustrations at left show a system with a single 3-wire feeder, but additional feeders can be tapped in and mounted on the pole as needed. Note the connections for bringing the power wires into an entrance head on yardpole, then down through conduit to the meter and circuit breaker.

Wiring beyond the meter. Note how wires running up from the meter to the feeder wires are run through the same conduit as the incoming power wires and out the same entrance head. ***Exception***—Some localities will not permit the unmetered and metered wires to run in the same conduit. Check your local REA or Power Company for ruling.

Mounting feeder wires. Feeders to the various buildings must run so that they touch nothing except their insulating supports and must be at least 8 feet away from trees, roofs or other obstructions.

Grounding at yardpole. Grounded wire is shown as a dotted line in illustration at left. It should be connected at top of pole to the overhead "neutral" wire and then run down to the ground on side of pole that is opposite the meter. Grounded wire should be copper, no smaller than No. 6, and must be fastened every 6 inches through entire length of its run. Run wire in conduit or armored cover in cases where it might be subject to mechanical injury.

Ground rod should be non-ferrous type, not less than ½-in. diameter and 8 ft. long. Locate at least 24 inches away from yardpole. Top of rod must be driven at least 12 inches below soil.

Be sure you check your local Code when you plan your wiring. Also be sure that the materials you intend to use are approved by your REA Cooperative or by your Power Company.

Wiring recommendations

Farmstead Plan Showing OVERHEAD WIRING

Many farmers prefer UNDERGROUND WIRING which has more advantages and is less subject to damage from storms and bad weather. *See page 57 for full details.*

Also see page 25 for use of low-cost plastic cable in underground wiring

for your complete farmstead

Capacity of the Wiring System. The size of the wiring system is obviously dependent upon the type of farm that you operate. Naturally a dairy farm which includes milk production will have more uses for electricity than a grain farm. In any case, the growth of the use of electricity on farms has been doubling every eight years and many wiring systems that were installed with 60-ampere service between the years 1935 to 1950 have become inadequate. Regardless of the type of farming that you do, it is probable that your wiring system is of insufficient capacity and that larger service entrances, branch circuits, and outlets are necessary. No farm is ever "overwired." With the relatively small investment of adequate wiring to the total investment of the farm, it pays good dividends to install adequate wiring.

60-ampere service for a farm is now practically obsolete. A 100-ampere service is the minimum and in many areas 150 to 200-ampere services are common. You should provide for the following:

[1] Enough branch circuits to all buildings to avoid too frequent use of long extension cords. Also enough circuits to prevent overloading, with resulting poor voltage and danger to running motors and electrical equipment.

[2] Special purpose 240-volt outlets for motor-driven equipment of ½ horsepower and over.

[3] Enough duplex outlets, conveniently located for smaller "plug-in" appliances and equipment.

[4] Plenty of switch-controlled lights where required to reduce eyestrain, prevent accidents.

[5] Enough switches to control lighting of stairs, silos, mows, from above and below, always located at the latch side of each door, to provide a path of light to and from each job.

[6] Separate grounding of all permanently-installed motors and other electrical equipment.

Size of Circuit Wires. Size 12 wire is recommended as the minimum size for all branch circuits. Experience shows that it is best to install large size wire on the farm. The difference in cost between smaller and larger wire sizes is relatively low, and installation charges are about the same in either case. Heavier wire provides the farmer with better service, assures greater safety, permits adding more equipment without overloading wires. In general, the size of the wire is determined by the length of the run, the electrical load to be carried and the maximum "voltage drop" permitted at the point of service.

Types of Installation. Wiring may be overhead or underground. The meter can be located on a pole or on the outside or inside of a building. However, the main service lines and the meter should be placed at a point as near as is practical to the electric load center of the farmstead. This is called "load center distribution." Feeder lines should be designed to hold voltage drops to a minimum, with particular emphasis placed on branch circuits serving brooders, heaters, and similar equipment in which life processes are involved.

Distribution System Shown on Opposite Page is a typical pole metering installation, with the meter and main disconnect switch located on the same pole. Feeder lines radiate from the distribution pole to all structures on the farmstead. Note the position of wires in relation to the various buildings. None pass through or over any of the structures. This is recommended for delivery of uninterrupted power and to minimize the possibility of service being cut off by fire in any of the buildings. The electric pump should be serviced direct from the yardpole so that it is available for pumping water in case of fire.

Outside Lighting—It is as necessary to light your way to the job as on the job. For that reason you need individual flood lights located at strategic locations with multiple control switches. (See page 27.)

A Farm Shop, so necessary on every mechanized farm, should have plenty of circuits, lighting and outlets for drills, lathes, saws, grinders, compressors, welders, etc., for construction and maintenance in addition to repairs of machinery.

Pressure Water Systems provide the farmer with water wherever he wants it. The electric pump should be supplied by a separate feeder and should be fused properly. Use thermostatically-controlled heating cable at exposed points to protect the water system from freezing. Pump is usually located in basement of house for cold weather protection and easier servicing. (In Southern states, where winters are usually mild and many houses built without basements, electric pumps are often located above ground in protective structures.) Faucets should be located at various points about the farmstead. The uses of running water about the farm are many and vital. Although no attempt has been made to illustrate them in this booklet, their importance cannot be overemphasized.

Your Local REA Cooperative Power Supplier will be glad to talk over your present and future wiring requirements and will suggest the type and size of wiring or equipment you will need.

Wiring recommendations for

Automation has come to the farm. Modern electrical labor-saving devices that work automatically go a long way to make dairying a more profitable enterprise. Automatic electrical equipment such as bulk milk cooling, barn cleaners, automatic feed grinders and mixers, taking grain from cribs and storing and preparing it in one operation is no dream—it's here. It is necessary to compete and farm profitably. Adequate wiring is necessary for all this equipment.

Feeder lines from the Yardpole are strung direct to dairy barn and a separate service entrance switch installed. Service entrance should not be less than 60 amperes for dairy barn alone, so that devices requiring 240-volts can be operated without overloading circuits. A separate ground, in the form of a driven ground rod, should be installed.

A minimum of five circuits as illustrated on opposite page are recommended for the average size barn and milkhouse:

Two 120-volt lighting circuits
One 120-volt circuit for milking machine
One 120-volt circuit for ventilators, fans, heaters
One 240-volt circuit for Bulk milk cooling or milk cooler.

Additional 240-volt circuits will be needed for:

- Silo unloader
- Feed Mixer
- Hay Storage Equipment
- Barn Cleaner
- Hay Dryer
- Feed Grinder

Non-metallic sheathed cable or dual-purpose plastic cable is most frequently used for barns and outbuildings, especially in dairy barns. Sheathed cable is resistant to moisture and dampness. The plastic cable is not only resistant to moisture and acids, but can even be used underground. Review pages 23 and 25 for details.

Barn and outbuilding wiring is essentially the same as house wiring. However, a few more precautions should be taken. Always run cable along the sides of beams or joists, rather than along bottom of joists. When cable runs crosswise to joists, studs or beams, run it through drilled holes rather than over surfaces, or protect it by running boards . . . the important point is to place cable where it will not be injured. Attach cable to studs, posts and interior parts of barn structure whenever possible, because wiring will then be less affected by weather than when on exterior walls.

Use porcelain or bakelite fittings. Metal switch and outlet boxes can also be used, but are less satisfactory because they will eventually rust. Check your local regulations on this point.

Location of switches. Switches are not indicated in wiring diagram on opposite page, but they can be located wherever convenient. The preferred location for switches is next to the main doorway. Each row of lights should be on a separate switch. If barn has two entrances, it is a good idea to wire one row of lights with a 3-way switch at each entrance. Milkhouse light should be controlled from separate switch at its own doorway. All lights should be equipped with reflectors.

Location of lights and outlets. Plan lights so that they are spaced over aisles behind stalls every 12 feet. Convenience outlets and all switches should be located high enough so cattle cannot touch them. Place outlets high on posts as shown, high on walls 15 feet apart, or suspended from ceiling on heavy-duty cords so equipment such as clippers or milkers can be plugged in.

Wiring the hayloft. In hayloft, for extra protection against combustion and pitchforks, use rubber-covered wire in conduit. A switch, equipped with pilot light to show when light is "on", should be installed on ground floor. Only general illumination is needed, so one or two lights are usually sufficient. Lights above hayline should be vapor-proof, dust-proof type to reduce danger of fire.

Wiring the milkhouse. Have at least one center light, plus other lights if needed above work areas. Provide at least three convenience outlets for cream separator, space heater, and small water heater. Bulk Milk Cooler or regular Milk Cooler needs a separate 240-volt circuit. Larger water heaters also require a separate 240-volt circuit.

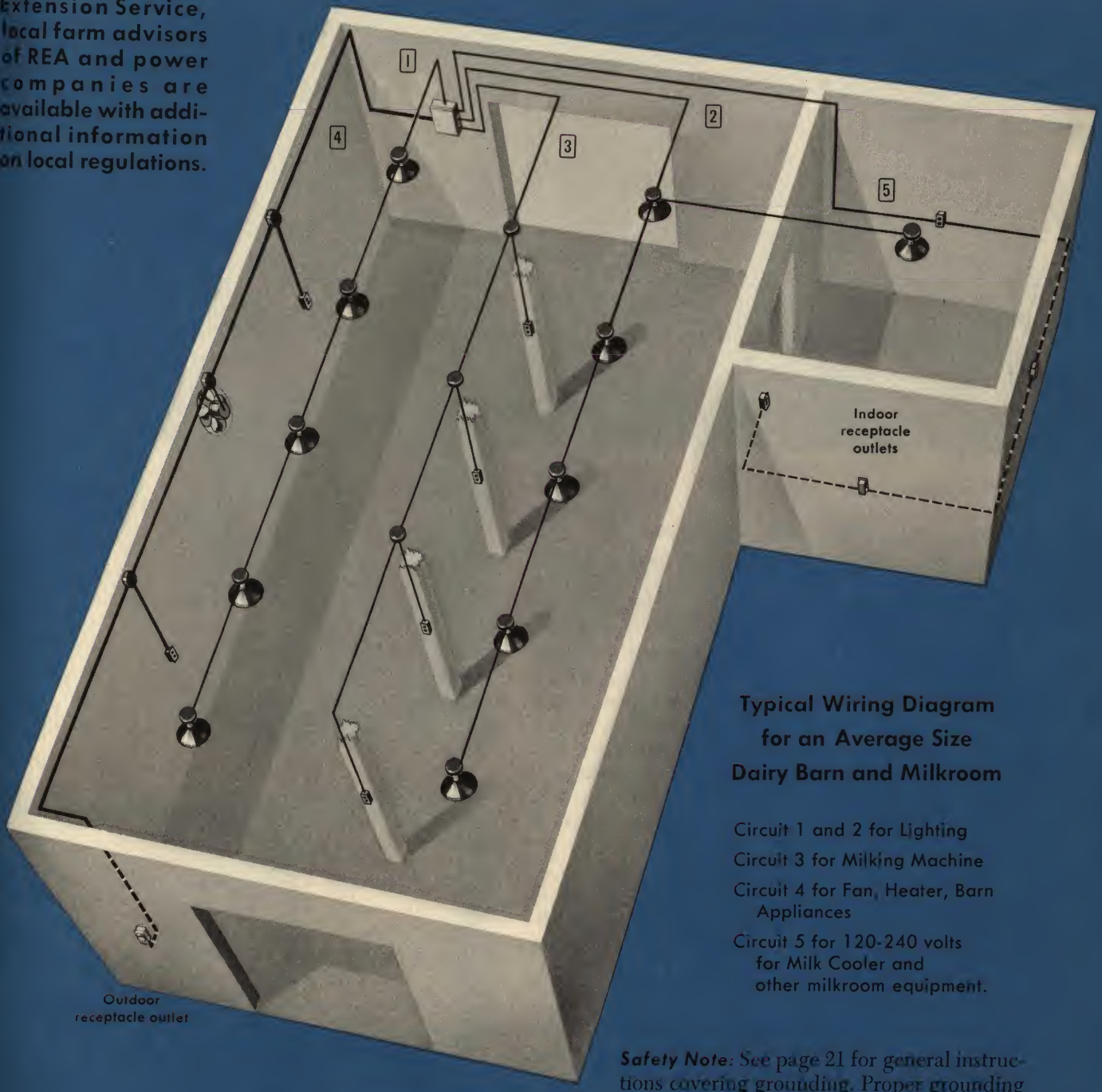
Wiring the silo. One or two of vapor-proof lights at top of silo are sufficient to light chute and silo. Switch, equipped with pilot light to show when light is "on", should be inside barn. Outlets for portable motors should also be provided.

Ventilating fans and motors. Small fans or motors can be plugged into any outlet, but the larger high wattage fans and motors should be used only on a 3-wire, 240-volt circuit. This circuit should have wire heavy enough to carry the load of 2 or 3 heavy-duty appliances at the same time.

Outdoor receptacles. To facilitate using motors and other equipment out-of-doors, at least one weatherproof receptacle should be installed outside of building. Connect to 3-wire 240-volt circuit.

the dairy barn and milkhouse

Your State College Extension Service, local farm advisors of REA and power companies are available with additional information on local regulations.



Typical Wiring Diagram for an Average Size Dairy Barn and Milkroom

Circuit 1 and 2 for Lighting

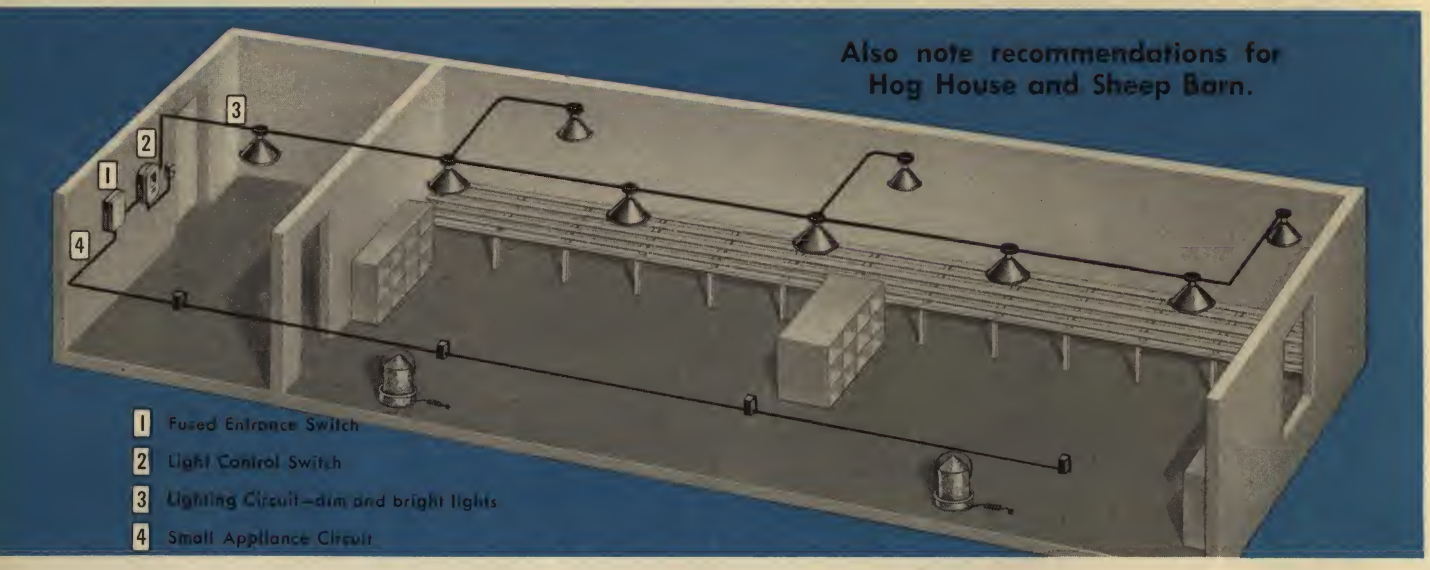
Circuit 3 for Milking Machine

Circuit 4 for Fan, Heater, Barn Appliances

Circuit 5 for 120-240 volts for Milk Cooler and other milkroom equipment.

Safety Note: See page 21 for general instructions covering grounding. Proper grounding is especially important in dairy barns and all other damp locations. Prevent tragic accidents . . . be sure every piece of equipment as well as your wiring system itself is correctly grounded.

Wiring the poultry house



For the average-size poultry house we recommend a 3-wire service entrance wired from yardpole when possible. Size of entrance switch is determined by the size of building and number of appliances you intend to use. A 60-ampere entrance switch will deliver power for four or five 120-volt circuits plus one 240-volt circuit for feed mixer or grinder and elevator.

Lighting circuit—Lights should be placed at least 6 feet high and equipped with reflectors. You can increase egg production by use of a light control switch which increases light hours in which to lay (13 to 14 hours of light every 24-hour period). These switches are automatic and can be set for any schedule you want. Connect all lights to both a regular Hand Controlled switch and the Automatic light control switch so that lights can be turned on by hand.

Other circuits—Plan a separate circuit as illustrated above for small appliances such as water warmers or one electric brooder. Additional circuits will be required for the following:

One 120-volt circuit for each additional large brooder.

One 120-volt circuit for each incubator.

One 120-volt circuit for germicidal or sun lamps.

One 240-volt circuit for Feed Mixer or Grinder or Elevator.

Feeding and Watering—A motor-driven automatic feeder takes care of the feeding problem, while water is supplied from a pressure system. Immersion heaters, heated fountains, and heating cable will help keep water and pipe lines from freezing.

Brooding—Use the modern infra-red hanging or hover-type floor brooders for automatic, safe operation producing healthy, faster growing chicks.

Feed Handling—A feed grinder and power-driven stationary elevator saves time and labor.

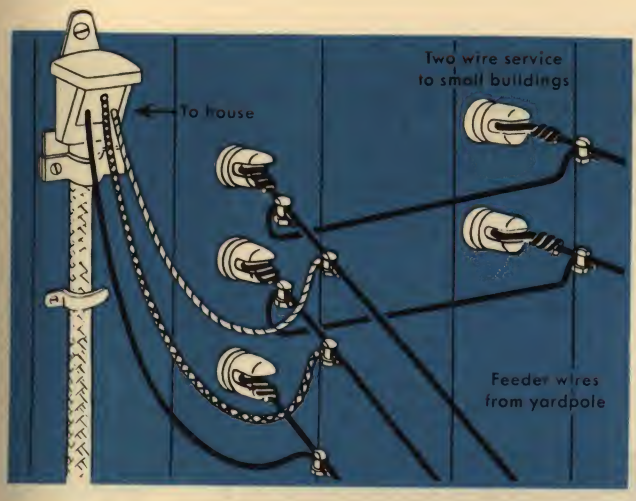
Non-metallic Sheathed Cable with bakelite or porcelain fittings is usually preferred for poultry houses and farm buildings, because it stands up better in damp locations. See page 23 for instructions on wiring with non-metallic sheathed cable.

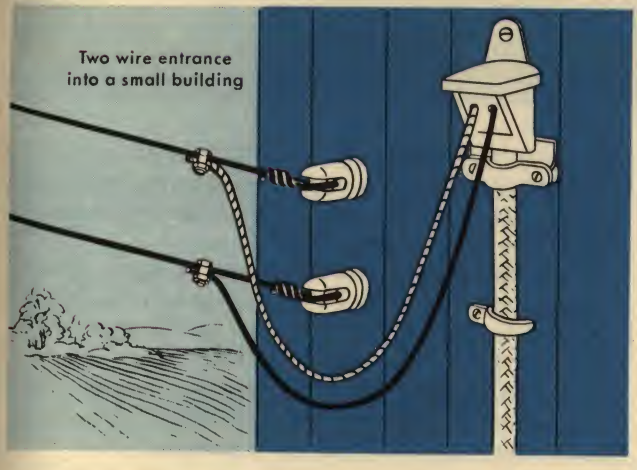
Workshop—3-wire entrance recommended. For the best possible working conditions, have 2 types of lighting—general lighting controlled by a single-pole switch, and localized lighting over work areas, controlled by pull chains. Provide plenty of outlets including a 240-volt outlet for heavy motors and electric arc welder.

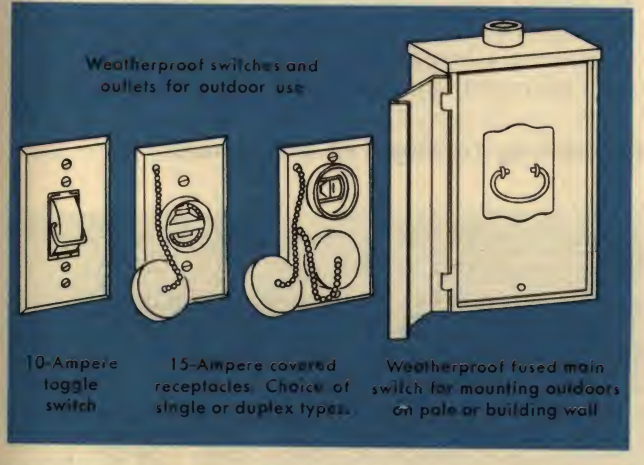
Hog House—2-wire entrance is usually sufficient. Lighting outlets, controlled by a single-pole switch located near door, should be placed along every 20 feet of alleys. For pig brooders, convenience outlets are needed in the farrowing pens. Place about 3 feet above floor, in corner of pen.

Sheep Barn—2-wire entrance is usually sufficient. A single row of lights, centrally located, is all that is necessary in barns 30 to 32 feet wide. In larger barns install 2 or more rows of lights. Provide outlets for lamb brooders and extension cords. Arrange to have the lights controlled by single-pole switch near the door for convenience.

Two wire service to outbuildings







Be sure to check your Local Electrical Code for information as to special regulations, if any, for your locality.

When running wires to outbuildings it is necessary that wires be heavy enough to carry the electrical load, and also necessary that the wiring be securely fastened to a strong, well supported building.

Tapping 2-wire from 3-wire service

Method shown at left is used ***only for systems wired from a yardpole.*** (See page 56 for 2-wire entrance with systems which do not have yardpole.)

Two-wire service should be planned only to outbuildings requiring a load of less than 3500 watts and using motors of ½ HP or less. The 2-wire lines may be run direct from the yardpole but usually it is easier to tap off wires running from yardpole to a neighboring building, provided those wires are heavy enough to carry the increased load. This method makes it unnecessary to wire through entrance switch of neighboring building. Usually the system is grounded at each building.

Two-wire service entrance

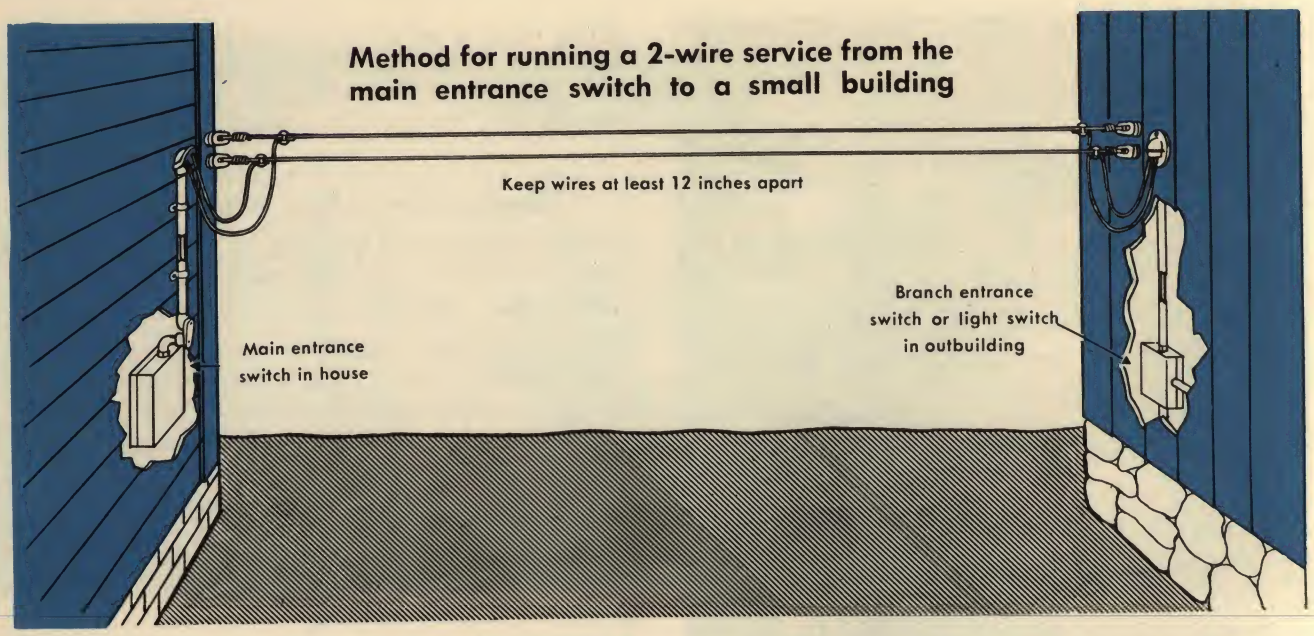
Regular weather-proof wire is used—8-gauge is recommended to withstand the strain of ice and wind. Insulators on buildings should be placed so that wires are at least 12 inches apart, and have a clearance from the ground of at least 18 feet over driveways; 10 feet over foot walks. Use either conduit or service entrance cable on the vertical run. Method of installing a 2-wire entrance is essentially the same as outlined on pages 19 and 20 except that 2-wire cable and a smaller entrance switch will be used. A 30-ampere 120-volt entrance switch is usually used, protected with fuses no larger than capacity of smallest wire.

Outdoor Switches and Receptacles

To use electrical equipment in damp locations and out-of-doors, weather-proof devices must be installed where motors and high-wattage farm equipment can be conveniently plugged into them.

Outdoor Switches and Receptacles vary in size. A 15-ampere receptacle is large enough for most jobs but if a large motor (½ H.P. or over) is to be used, heavier switches and receptacles are needed and they must be installed on a 3-wire 240-volt circuit. When wiring receptacles, connect black or red wires to the dark-color terminal, and the white wire to light-color terminal. If wires run underground the same rules apply as stated on page 57.

Overhead wiring



Method for running a 2-wire service from the main entrance switch to a small building

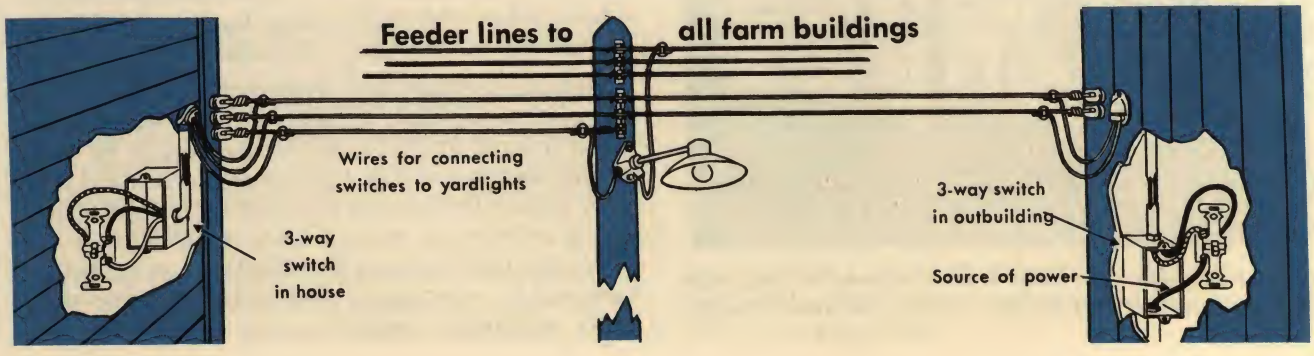
A garage or out-building generally requires a small electrical load. Wiring method above is for building to building. It cannot be used with systems wired from a yard pole (see page 55 for yard pole systems). Since overhead wiring is susceptible to winds and ice, a durable installation is necessary.

Installation—When main entrance switch is inside house, come through wall and up side of building with 2-wire number-8 entrance cable to entrance head. Use number-10 weatherproof wire for runs under 50 feet and number-8 over 50 feet. When entering a building, as shown on the right, and the wires go down the inside of the building, use a flange-type entrance head with conduit, armored or sheathed cable. The same type of head could be used in the installation as shown on the left, and you could run up the inside of the building with conduit, armored or sheathed cable. The loops from the overhead wires are made from the entrance heads to insulated brackets at least 15 feet above ground.

Wiring within outbuilding is determined by amount of electricity required. A toggle switch is enough for a few lights and receptacles . . . but an entrance switch must be installed for branch circuits.

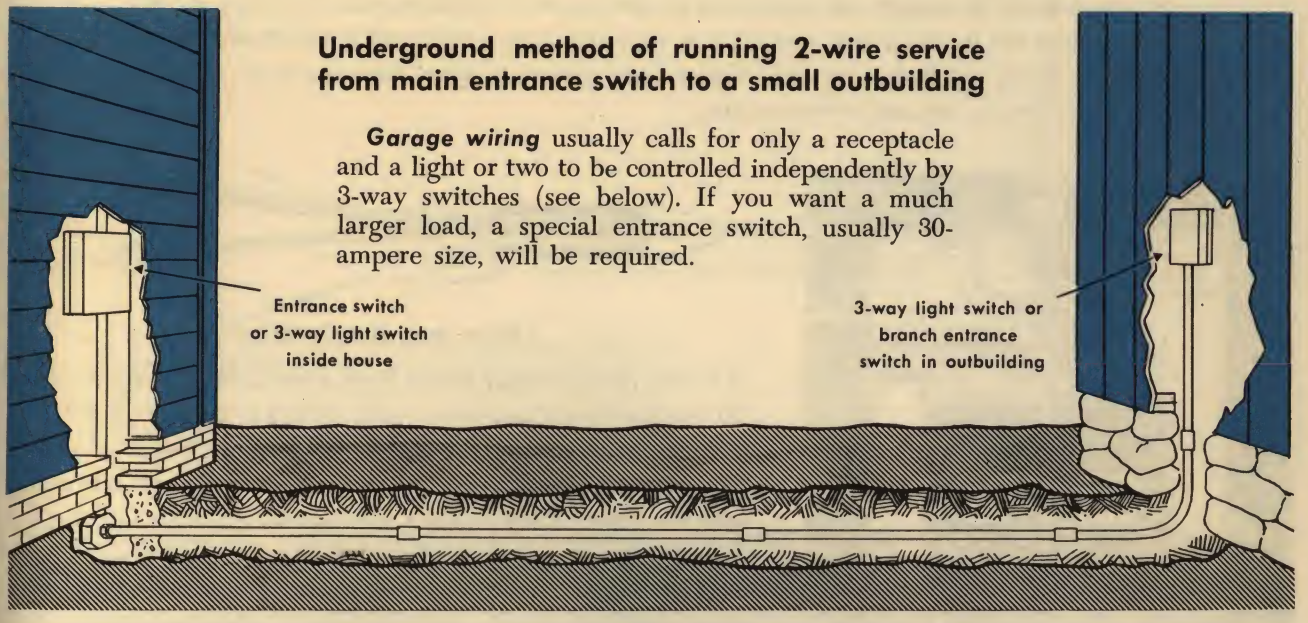
Mounting yardlight on a yardpole—Assuming that barn is already wired, and using the installation shown below, the yardlight may be controlled from both house and barn. 3-way switches are used. Note that in hookup below, there are three wires from house to yardlight, and only two wires from light to the barn. This saves a length of wire by simply tapping "neutral" off feeder wire on yardpole.

View below shows common method of mounting Yardlight on a Yardpole



PART 6

Underground wiring



Underground method of running 2-wire service from main entrance switch to a small outbuilding

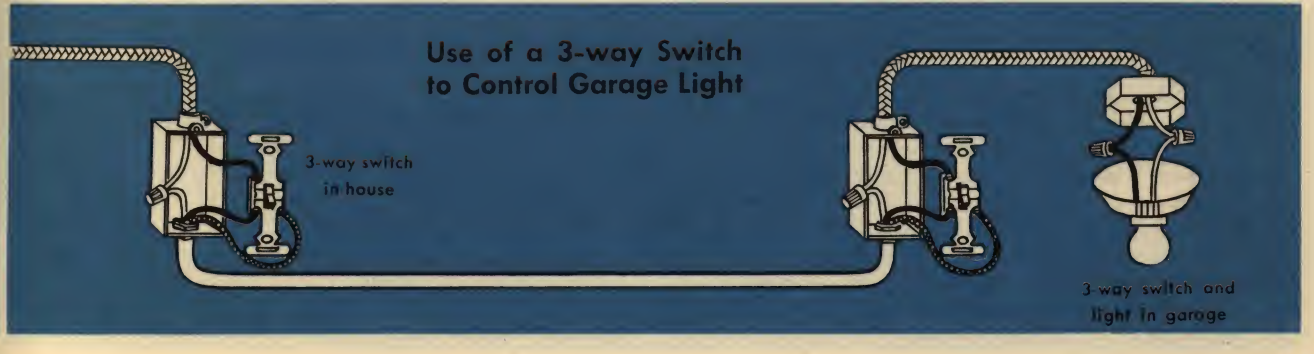
Garage wiring usually calls for only a receptacle and a light or two to be controlled independently by 3-way switches (see below). If you want a much larger load, a special entrance switch, usually 30-ampere size, will be required.

Underground wiring is usually used to run to outdoor outlets. (See pages 40 and 41.) Another frequent use is to garages, barns or outbuildings where overhead wires would be in the way. There are three types of underground wiring: (1) dual-purpose plastic cable. (See page 25.) (2) trench cable and (3) lead cable. Trench cable, which is single wire, is usually used for underground services of larger sizes. Lead cable consists of 2 or 3 wires in a lead sheath. Whenever underground wiring is subject to mechanical injury, such as under heavily used driveways, these wires should be enclosed in conduit. Check Local Code for types of underground wiring approved in your area.

Number-10 or Number-12 two-wire lead cable may be used in ¾-inch conduit; two Number-8 or three Number-10, 12 or 14 wires may be used in 1-inch conduit. If possible, bury the conduit, or any other type of underground wiring, 18 to 24 inches below the frost line, to prevent heaving or condensation.

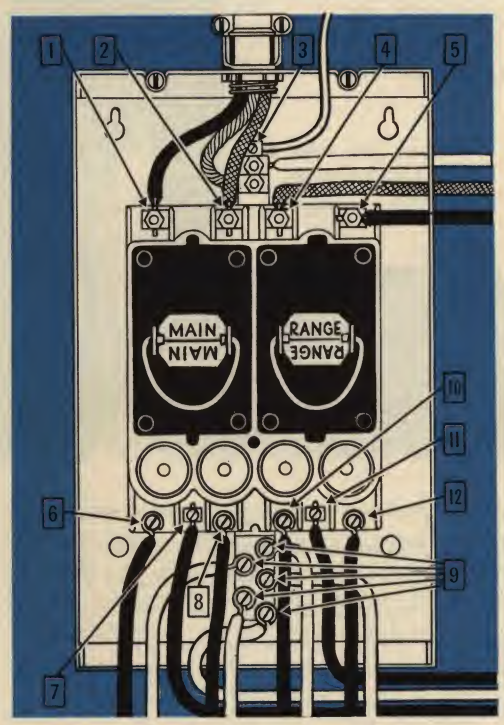
Installation is made as shown above. Wires may be tapped off of a junction box or entrance switch in the house, run down and through the basement wall. The wall must be sealed where conduit enters building for protection against seepage of water. This conduit is then run through the wall of the outbuilding and up to a junction box or a subpanel, if more than one circuit is necessary.

Grounding: If you have a grounded system (one where the wiring is in conduit or in armored cable) it is advisable, on underground runs with dual-purpose plastic cable to another building, to use 2-wire cable with a bare ground wire. The bare ground wire thus provides a continous ground connecting all boxes in the system, both those inside the house and those inside the new building you are wiring.



Methods and devices for testing

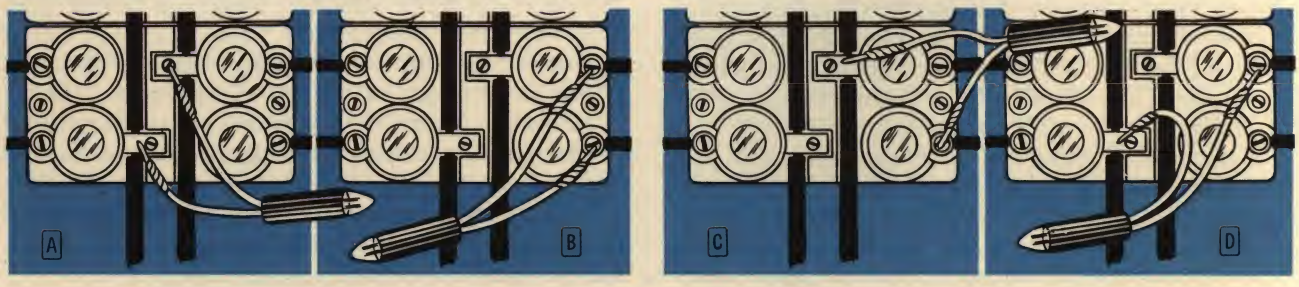
The most common fuses are plug or cartridge fuses. Plug fuses are the screw-in type available in 10-15-20-25-30-ampere size and used in the home for lighting and appliance circuits. Cartridge fuses are the long type (available in 10 to 60-ampere size) used for the main, range, dryer or other heavy appliance circuits. Always keep plenty of spare fuses on hand. It takes only a minute or two to test and replace a fuse.



Fuse and circuit tester

It is very easy to locate blown fuses when using the above tester. To test for blown fuses in a panel similar to the one at left, first test the main service. Do this by holding the insulated tips of the tester and touching terminal 1 with one tip and terminal 3 with the other. If lamp glows, this side of service is OK. Repeat the same procedure on terminals 2 and 3. To test the range fuse, touch tip of tester to terminal 3, the other tip to 4. Repeat the same procedure on terminals 3 and 5. If light glows, then range fuse is OK.

To test the lighting and appliance circuits touch one tip of tester to terminal 6, the other to 9. Repeat this procedure on terminals 8 and 9, 9 and 10, 9 and 12. To test main fuse, touch one tip of tester to terminal 7 and the other to terminal 9. Repeat this procedure on terminals 9 and 11. If lamp glows on any of the above tests, the fuses are good. If not, replace fuse.



Testing fuse blocks which have 2 fuses for each circuit

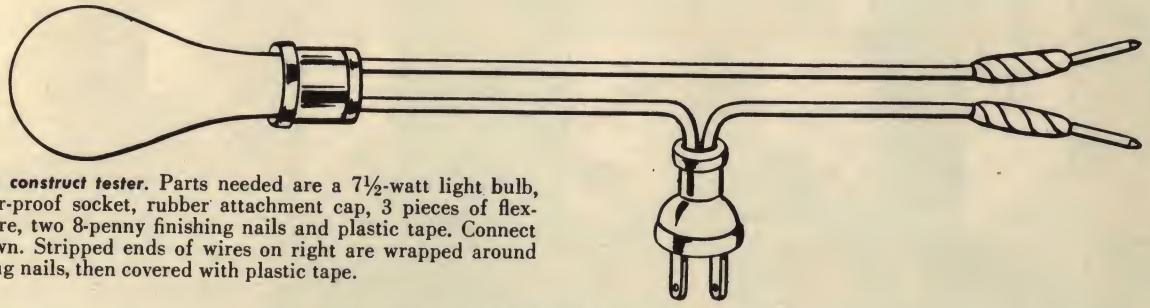
If light glows when testing as shown in figure A above, main fuses are OK. If light does not glow, test main fuses to find the blown fuse. When testing as shown in figure B above, and light glows, then fuses are good. If light does not glow, then test as shown in figures C and D until you find the blown fuse.

How to locate a short circuit in your wiring or appliances. If one of your fuses continually blows, you may have a short circuit in your circuit wiring, or one of your lamps, lighting fixtures or appliances may be defective. To test: First turn off all ceiling lights, shut off all wall switches, and disconnect all cords, lamps and appliances on that particular circuit. Now take a 100-watt light bulb and screw bulb into fuse holder which holds the fuse that keeps blowing. If bulb ***does*** light, with nothing plugged in, you have a short in the circuit wiring itself. If bulb ***does NOT light,*** your circuit wiring is OK, ***but you may have a short*** in one of the lamps, light fixtures or appliances on that circuit. In this case you will have to plug in each item on the line, one at a time! When the item being tested is a lamp or light fixture, if the bulb in fuse holder burns bright, but lamp or light fixture does not light up, you have a short in that item.

In the case of a heavy-wattage appliance, such as an iron, a roaster, a heater or a toaster, it is free from short if it starts to become warm a few minutes after you plug it in, and the bulb in fuse holder burns to full brightness at the same time.

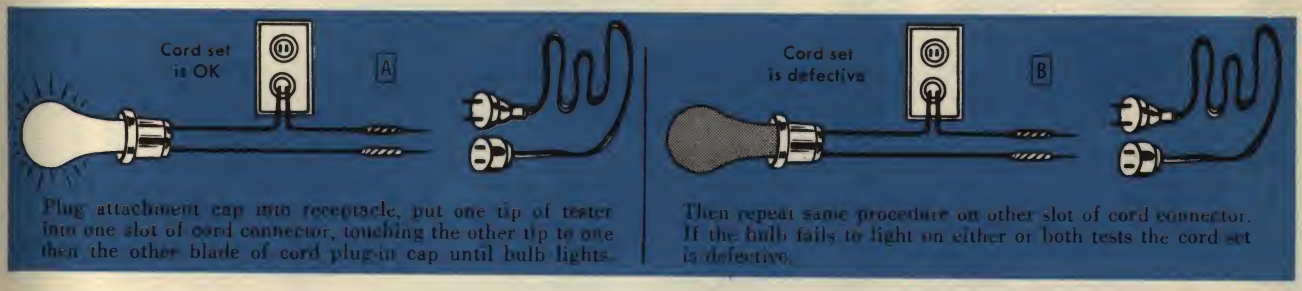
fuses, circuits, cords and appliances

There are various types of testers available. Each serves a specific purpose. The tester shown below is used to test circuit wiring on cord sets or appliances. It is also used to test current leakage on appliances, motors, etc. ***Warning:*** do not touch exposed ends with hands when attachment cap is plugged into receptacle.



How to construct tester. Parts needed are a 7½-watt light bulb, weather-proof socket, rubber attachment cap, 3 pieces of flexible wire, two 8-penny finishing nails and plastic tape. Connect as shown. Stripped ends of wires on right are wrapped around finishing nails, then covered with plastic tape.

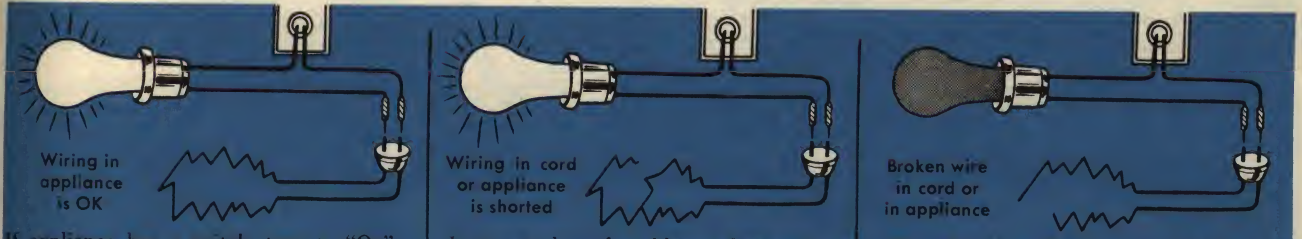
How to test all types of cord sets



Plug attachment cap into receptacle, put one tip of tester into one slot of cord connector, touching the other tip to one then the other blade of cord plug-in cap until bulb lights.

Then repeat same procedure on other slot of cord connector. If the bulb fails to light on either or both tests the cord set is defective.

How to Locate Source of Trouble When an Appliance Does Not Operate Properly



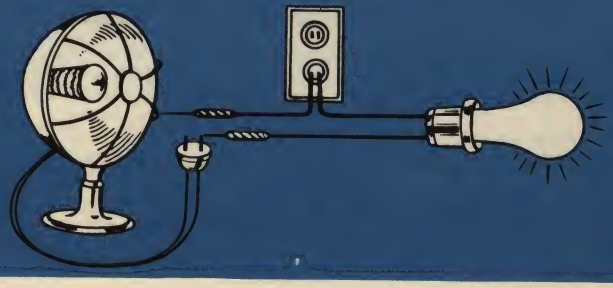
If appliance has a switch, turn to "On" position before making this test. Then plug in tester and touch tips of tester to blades on the appliance cord cap as shown. If bulb lights up, the appliance is OK, but either the receptacle or the circuit wiring is defective.

In cases where fuse blows whenever the appliance is plugged in, repeat procedure at left. If bulb lights, the appliance or cord is defective. Disconnect cord from appliance and test it as in A and B above. Test appliance separately by applying tester to terminals.

If bulb fails to light up when making test as shown, it means that you have an open circuit within the cord set or the appliance itself. Next detach cord and test the terminals of appliance. If no light, appliance has bad element which must be repaired. If bulb lights, try new cord set.

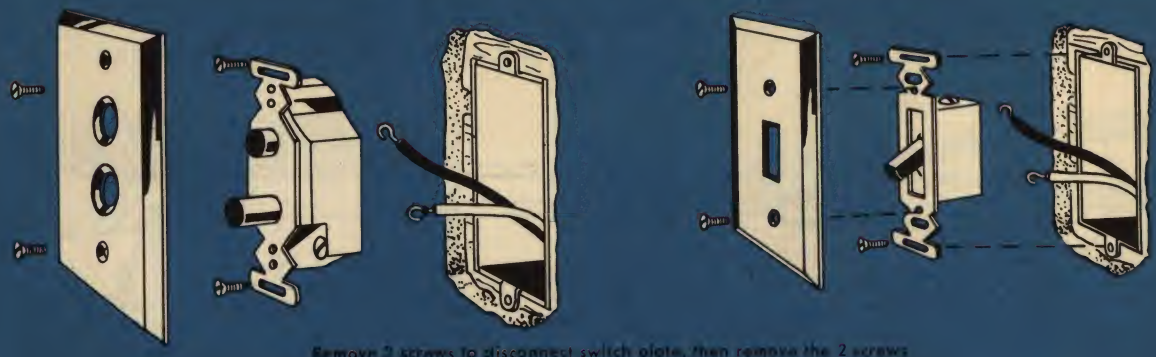
Testing for current leakage (shock)

Plug attachment cap from tester into receptacle. Touch one tip of tester to metal frame as shown above, touch the other tip to one or the other blades on the attachment cap from the appliance. If the bulb fails to light when touching either blade there is no dangerous current leakage. If the bulb lights, you have an internal leakage, a bare or uninsulated wire touching the frame of the appliance. This may cause a shock. Locate trouble and correct or have appliance repaired.

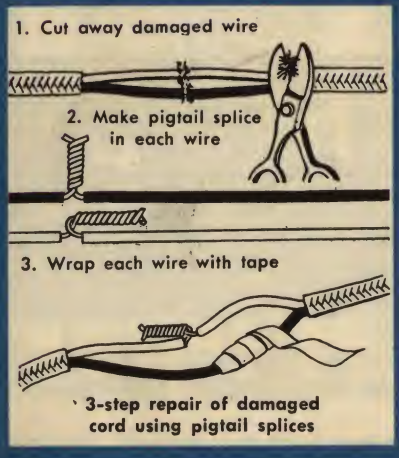


How to replace switches, repair cords

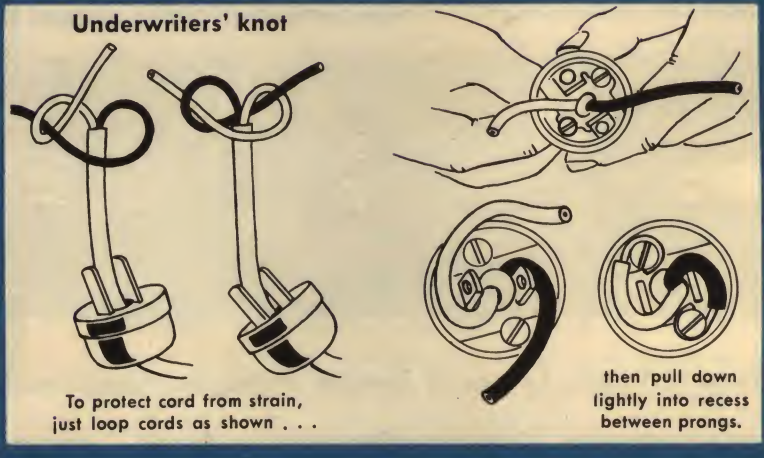
Replacing old push-button type with toggle switch



Remove 2 screws to disconnect switch plate, then remove the 2 screws connecting switch to box. Hook up wires exactly as before.



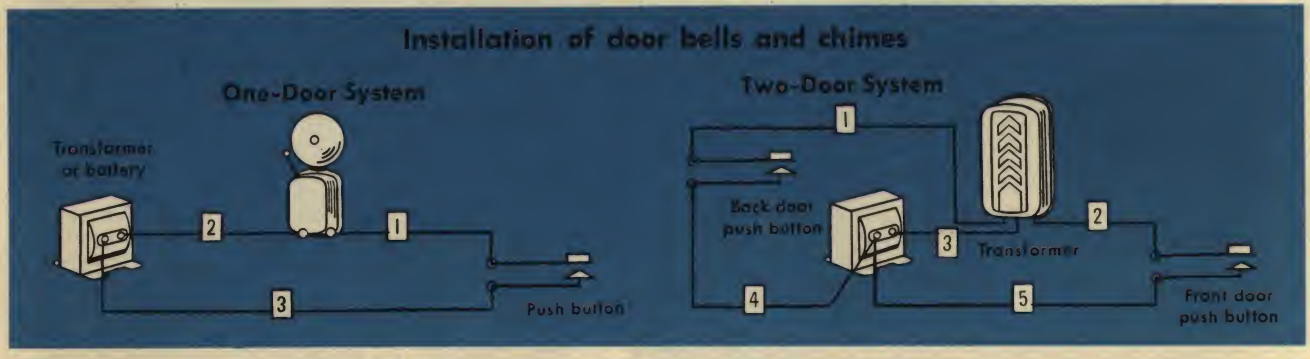
3-step repair of damaged cord using pigtail splices



To protect cord from strain, just loop cords as shown . . .

then pull down lightly into recess between prongs.

Installation of door bells and chimes



Doorbells, buzzers, and chimes operate at low voltage through a transformer; though dry cell batteries may also be used. Transformers reduce 120-volt alternating current to lower voltage, such as 6, 8, 10, 12, or 18 volts. Because of this low voltage, heavy insulation is not required. Bell wire is used from low voltage side of transformer and may be run behind baseboards, under molding, or floor boards.

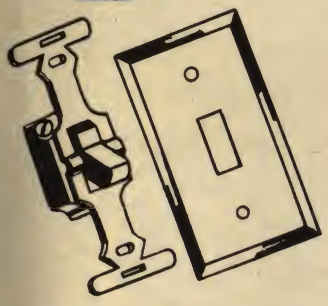
Sometimes it is necessary to wire doorbells from 1½-volt batteries connected in series to produce voltage needed. For example, a 6-volt doorbell would require four 1½-volt batteries.

Doorbell only, shown above, gives the simplest type installation. Wire (1) is run from terminal on the bell to push button and wire (2) to the transformer (or batteries). Another wire (3) is then run from push button to transformer.

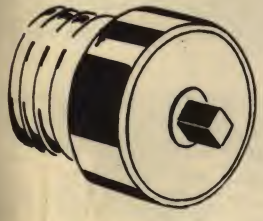
Two-Door System. Signal bell for the front door and a buzzer for the back door. Connect wire (1) and wire (2) from terminals on combination bell and buzzer to the push buttons; connect wire (3) to transformer. Next connect two wires (4) and (5) from terminal on transformer to each push button.

Chimes. Essentially same as above. Most chimes require 10-volts. For best service a special chime transformer is necessary.

Basic wiring devices and their uses



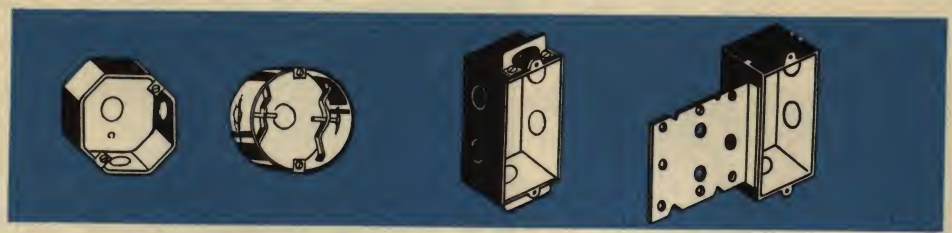
Bakelite Toggle Switch and Plate. Fits any standard flush-mounted or surface-mounted switch box. Easy to wire and mount. Choice of single-pole, 3-way or 4-way types. Choice of Ivory or Brown finish. Also available in silent "Mercury" type which eliminates annoying clicks, making it ideal for bedrooms, sickrooms, children's rooms. Sears also features a single-pole Illuminated switch with tiny built-in glow-bulb which stays "On" in the dark, making it easy to find switch at night without groping. Costs only 10c per year for current.



Precision-built MINI-BREAKER ends all fuse-changing. Converts old fuse box into an Automatic Circuit Breaker. Screw one into any fuse socket. Trips at once on dangerous overloads yet absorbs temporary overloads from washer, refrigerator or motors without tripping. Colored Trip ring shows which MINI-BREAKER has blown. Just press button to restore current. Available in 15, 20 or 30-ampere.

Heating Cable aids in preventing frozen water pipe, gutter, troughs and animal drinkers . . . keeps hot-bed plants from freezing. Lead-covered, flexible and easy to handle. Insulated, weatherproof, safe for indoor or outdoor use, plugs into any 120 volt AC line. Available in 20-40-60 foot loops for roof de-icing, soil heating, or warming water pipe, waste pipe, or oil pipe to prevent freeze-ups. Weatherproof. Lasts a lifetime.

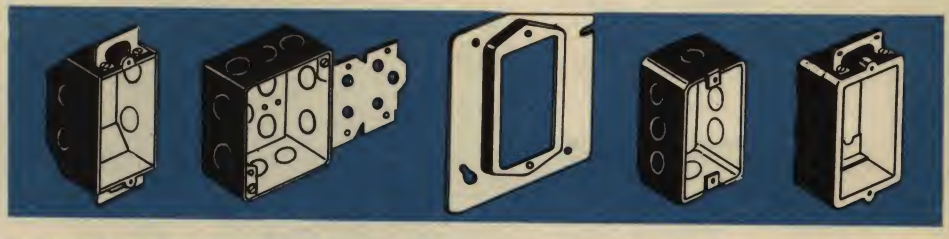
See page 25 for Surface Wiring Devices



Octagon Boxes for Drop Cord Fixture or Junction Outlets. Use with conduit, armored cable or non-metallic cable. Available with or without cable clamps and in steel or bakelite. Steel boxes are recommended for use in house and dry locations, bakelite boxes for use with non-metallic cable or plastic cable in basements, barns, laundries, and damp locations.

Steel Boxes are recommended for switch, receptacle and bracket outlets in the home. Available with or without clamps. Two or more can be joined by removing one side plate on each box and hooking boxes together.

Steel Outlet or Switch Boxes with Wall Mounting Brackets are used in NEW work only. The brackets must be mounted to allow the correct depth for lath (or sheet-rock) and plaster or wood paneling. Available for use with connectors or with handy built-in clamps.



The beveled corner box at left is used for easy fitting into wall opening in old buildings. Has clamps for loom or non-metallic sheathed cable . . . no connector needed. The side-bracket box in center is used with cover at right in new work whenever extra space is needed for wires. Used for switches, receptacles and bracket outlets, available with combination ½" and ¾" knock-outs, requires connectors. For use with armored, non-metallic or plastic cable or with conduit.

Bakelite Switch and Receptacle Boxes. The box on left is for surface mounting . . . screw to wall surface in exposed wiring. The box on right is for concealed work, where outlet is flush with wall. Comes complete with cable clamps . . . no connectors needed.

Bakelite Duplex Wall Outlet and Plate. Fits any standard flush or surface mounted switch box. Has mounting bracket for aligning with wall surface.

Clock Outlet with Hanger. Receptacle is recessed so it holds both plug and wire. permitting clock to hang flush with wall surface.

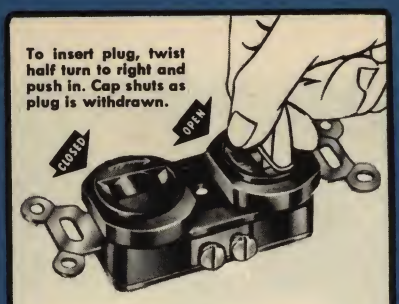
Porcelain Pull Chain Outlet with Receptacle. Receptacle is always "alive." Fits any octagon box. Use porcelain or bakelite to protect against corrosion in damp locations.

Fused devices protect low ampere capacity motors on appliances, power tools, etc. Fits standard switch boxes. Device on left has fuse holder for lag fuse, also receptacle with "U" shape ground. Device on right has fuseholder for lag fuse and a switch.

Weatherproof Receptacles, Switches and Boxes for mounting outdoor. The receptacles, with weatherproof screw-on covers, are available in single and duplex type. The switches are available in single and 3-way. The boxes are available in one or two ½ inch hubs. These outdoor devices are used for decorative lighting, Christmas lighting, temporary yard lights, patio lighting, or any other outdoor installation.

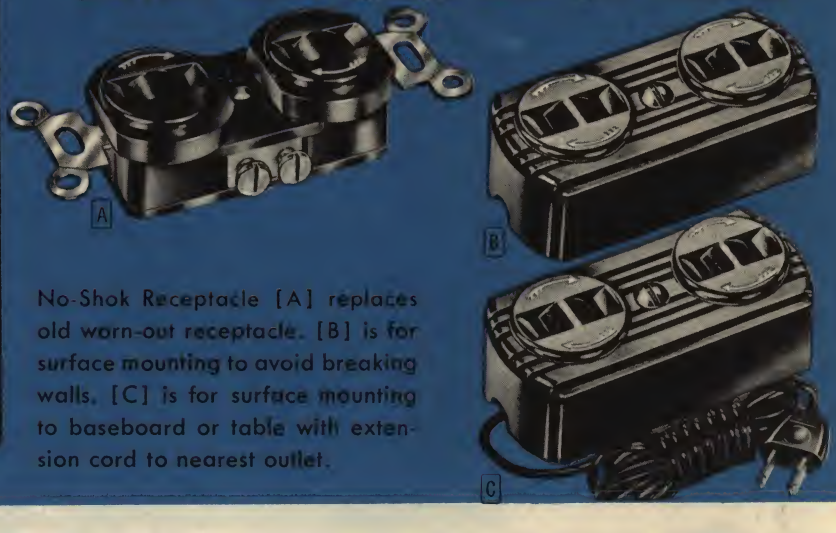
Plug and Cartridge Fuses are safety valves that protect wires against overloads. Amperage of fuse should never exceed the amperage of the circuit that fuse is designed to protect.

Dryer or Range Pigtails and Receptacles are more convenient than permanent installations as range or dryer can be moved more easily for cleaning. Receptacle connects from entrance switch.



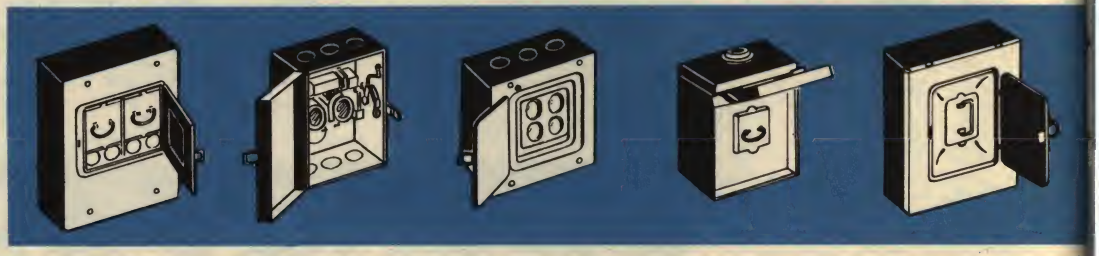
These safety-type receptacles keep small children from inserting hairpins, wires, scissors or toys into current-carrying parts. When rewiring, be sure to include them in your plans. Available in Brown or Ivory color.

NO-SHOK safety installations protect children from shock and burns... prevent short circuits and fire hazards



No-Shok Receptacle [A] replaces old worn-out receptacle. [B] is for surface mounting to avoid breaking walls. [C] is for surface mounting to baseboard or table with extension cord to nearest outlet.

Types of Indoor and Outdoor Switches and their Uses



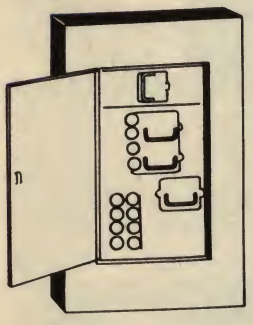
Fused Entrance Switch. Uses cartridge fuses and plug fuses to provide protection for main service Range circuit and branch lighting and appliance circuits, has 60 ampere power takeoff lugs.

Fused Indoor Safety Switch. Use as an entrance switch for small building or to provide fuse protection for Water Heaters or Large Motors, etc. For 2 or 3-wire, 120 to 240 volts.

Surface Mounted Fuse Cabinet. Use with safety switch at left or connect to power takeoff lugs on main entrance switch, wherever additional circuits are required from main line.

Heavy-Duty Outdoor Weatherproof Entrance Switch. For handling large service loads and heavy duty appliances 120-240 volts, 60 amp. 3 wire solid neutral. Has hinged cover.

Entrance Switch. Use as a main line disconnect or can be easily connected to main line or power takeoff lugs, as a Range or High-Speed Dryer Circuit 60 ampere, 120 to 240 volts.



Extra-Heavy Duty Fused Entrance Switch, with 100-ampere main breakers, one Fused Range pullout, two 30 ampere fuse pullouts and 12 lighting and appliance circuits plus power takeoff Lugs. Designed to meet all your adequate wiring needs for many years to come.

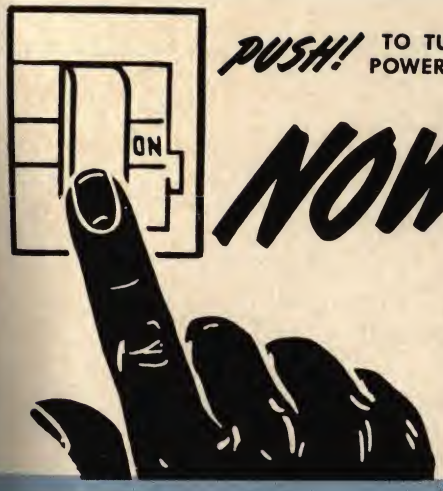
Outdoor Circuit Breaker Entrance Switch. Use as a main line disconnect in areas where local code demands. A main switch is necessary when 6 or more breakers are installed. Rated 100 ampere 120 to 240 volts.

Indoor Circuit Breaker Entrance Switch. Serves the same purpose as outdoor switch at left, except that it is designed exclusively for indoor use and is not weatherproof. Do not use out of doors.

Outdoor Meter Socket Available in 1 and 1¼ inch sizes, 2 and 3 openings. In many cities the customer must purchase these sockets, but usually it is supplied by Power Co. Check your power company.

Hot Water Heater Switch. Has 2 Toggle switches and fuses for two circuit one switch and fuse for upper element, one switch and fuse for lower element; 30 amp. 120 to 240 volts.

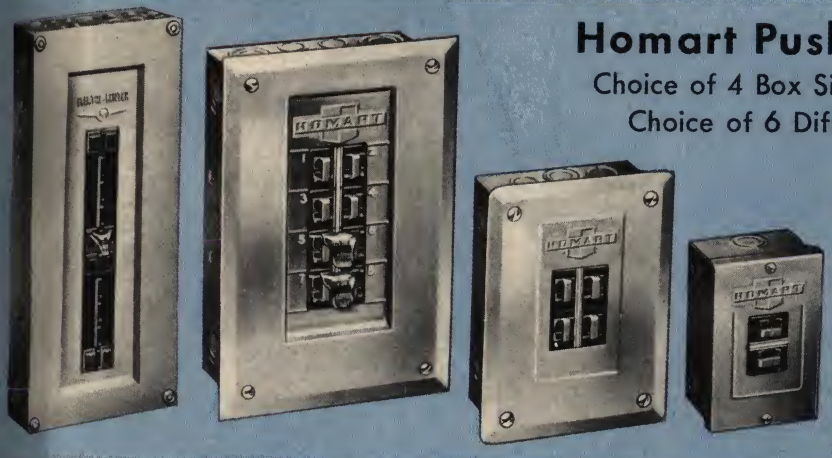
Time Switch. Heavy duty 30 amperes, 120 volts. Ideal for controlling protective lighting, signs, hall lights, pumps, blowers, signal systems, attic fans, store lighting. On and off cycle, 1 hour to 23 hours.



PUSH! TO TURN POWER ON **PUSH!** TO TURN POWER OFF **PUSH!** TO RESTORE SERVICE WHEN OVERLOAD TRIPS BREAKER

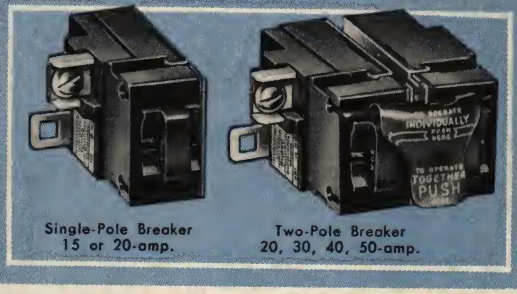
NOW! No more fuses to change!

Make up the Entrance Switch you want Equipped with "Push-Button" On-Off *plus* Automatic Overload Control



Homart Push-Breaker Centers

Choice of 4 Box Sizes, Flush or Surface Mount
Choice of 6 Different Size Push-Breakers



Single-Pole Breaker
15 or 20-amp.

Two-Pole Breaker
20, 30, 40, 50-amp.

Push-Breaker "Servicenters," the newest development in Automatic Fuseless Entrance Switches. Replace both fuses and main switch. Now, you can "Custom-design" your own Service Entrance, adding to it or changing it at any time in the future. Assures greater flexibility in providing for future electrical loads at lowest cost and will frequently save you the expense of costly rewiring in future years.

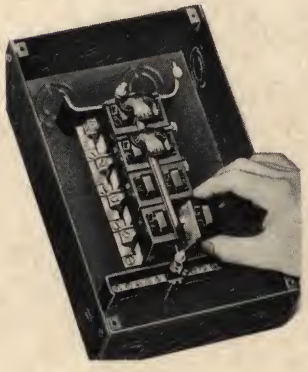
Thermal-Magnetic Push-Breakers take harmless short-period overloads without tripping . . . yet give complete protection against prolonged overloads. To turn power on or off, or to restore power after an overload, just push button!

Here's how they work. You select from the 4 "Servicenters" shown above, the 18, 8 or 4-circuit size for general use . . . the small 2-circuit size as a safety switch for use with motors, Water Heaters, or as a switch in small buildings. Then buy the Push-Breakers separately (in whichever ampere rating you require) and just lock them into the Servicenter as shown at right. 6 sizes to choose from . . . the 15 and 20 ampere Single-pole Breakers are interchangeable, designed for general lighting circuits or small motor control . . . the 20, 30, 40 and 50-ampere Two-pole Breakers are also interchangeable, designed for range, dryer and heavier appliance circuits or as a sub-feed to other service panels.

"Servicenters" are available for either flush or surface mounting. Fully UL Approved . . . meet all REA specifications. See your Power Company for Circuit amperages recommended for your particular installation.

To order "Servicenters" and Push-Breakers see Sears' Big General Catalog or visit your nearest Sears Retail Store.

Change amperage of any circuit at any time just by installing a new Push-Breaker. Push-Breakers lock in place in seconds.

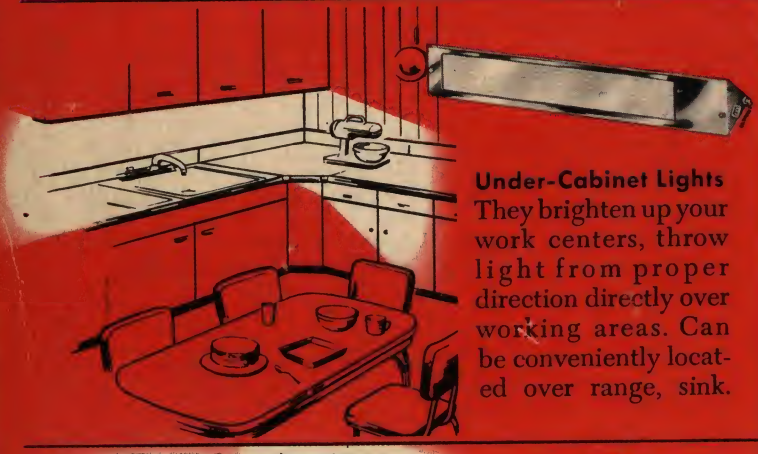


Why settle for HALF a lighting system

Note these 8 Improvements in Modern Lighting.

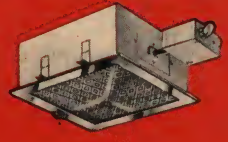
Adjustable Lights
Pull down or push up at the lightest pressure to give you all-purpose light at exact height wanted.

Post-top Lights
They offer extra safety, light up your lawn and garden, make your home easier to identify. See page 25 for new low-cost installation.



Under-Cabinet Lights
They brighten up your work centers, throw light from proper direction directly over working areas. Can be conveniently located over range, sink.

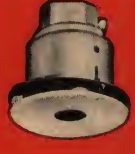
Cornice Lights
They diffuse the light, "bounce" it off ceiling to bring out the beauty of walls and texture of draperies. Assures better-seeing too, free from harsh glare.



Recessed Lights
They produce a modern "built-in" effect... all that extends down is the frame and glass panel. Ideal for kitchen, bath, or any room with low ceiling.

Shaded Fluorescents
They provide powerful glareless "down" light almost like daylight. Bigger sizes to flood entire room with light. Shades just lift off for quick cleaning.

Swivel Spotlites
They turn from side to side, tilt up or down to spotlight pictures, beds, tables with bright decorative beam. Also for reading, sewing.



Pin-point Lights
Dramatize small areas of dining room or living room. Use two over a dining table. For decorative accent only; not for full room.

Why settle for HALF a lighting system

Modern Lighting.

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From the collection of:

Alan O'Bright

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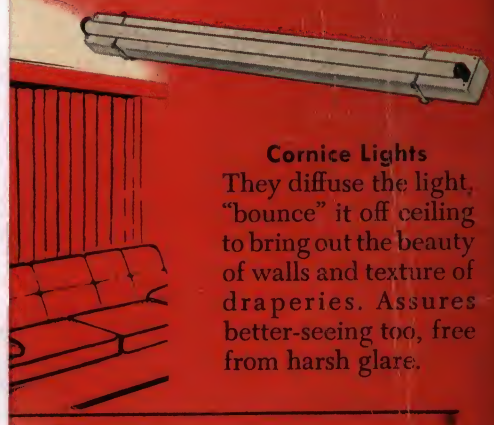

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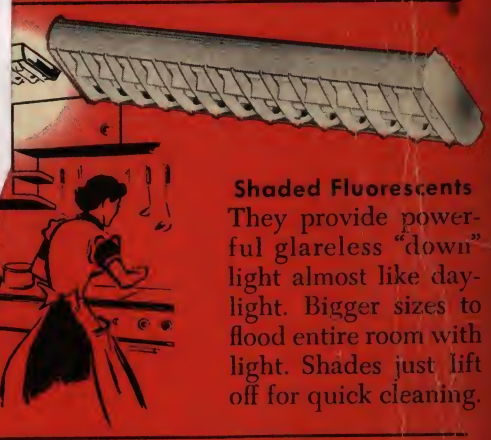

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